DOCUMENT RESUME

ED 114 485 95 CE 005 149

AUTHOR	McCracken, J. David, Ed.; Newcomb, L. H., Ed.
TITLE	Inservice Education of Vocational Agriculture Teachers on New Curriculum Materials for Adult Class Instruction: Final Report.
INSTITUTION	Ohio State Univ., Columbus. Dept. of Agricultural Education.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.; Ohio State Dept. of Education, Columbus. Div. of Vocational Education.
PUB DATE	Aug 75
NOTE	763 p.; Illustrations in appended materials are marginally reproducible
EDRS PRICE	MF-$1.23 HC-$34.91 Plus Postage
DESCRIPTORS	*Adult Farmer Education; *Agricultural Education; Agricultural Engineering; Agricultural Production; Farm Management; Horticulture; Teacher Developed Materials; *Teaching Guides; *Unit Plan; *Young Farmer Education

ABSTRACT

Twenty-two field-tested instructional units were developed for use in adult and young farmer education by 20 specially trained agriculture teachers in Ohio. The resource units were developed in the following agriculture areas of instruction: corn and soybean production, agriculture mechanics, swine production, farm management, and horticulture. Each unit is presented with topic outlines, illustrations, and descriptions. Subjects discussed within each unit include the following areas: State situation, local situation, objectives, references, needed audiovisual equipment, interest approaches, questions to be answered, learning activities, to summarize (note to teacher), applications, and appended materials on content summary and instructional materials. (Author/ED)

Documents acquired by ERIC include many informal unpublished materials not available from other sources. ERIC makes every effort to obtain the best copy available. Nevertheless, items of marginal reproducibility are often encountered and this affects the quality of the microfiche and hardcopy reproductions ERIC makes available via the ERIC Document Reproduction Service (EDRS). EDRS is not responsible for the quality of the original document. Reproductions supplied by EDRS are the best that can be made from the original.

SEP 29 1975

U S DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION

FINAL REPORT

J. DAVID MCCRACKEN

L.H. NEWCOMB

DEPARTMENT OF AGRICULTURAL EDUCATION
THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO 43210

1975

CE 005149

FINAL REPORT OF EPDA PROJECT NO. 74132, PART F, SECTION 553

TITLE: INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION

INSTITUTION:
DEPARTMENT OF AGRICULTURAL EDUCATION
COLLEGE OF AGRICULTURE AND HOME ECONOMICS
THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO 43210

DATE PROJECT COMPLETED: AUGUST 31, 1975

PRIORITY: THE PRIMARY PURPOSE OF THIS PROJECT WAS TO TRAIN VOCATIONAL AGRICULTURE TEACHERS IN THE USE OF IMPROVED INSTRUCTIONAL UNITS IN ADULT AND YOUNG FARMER EDUCATION.

PROJECT RESULTS:

APPROXIMATELY 20 TEACHERS WERE TRAINED IN THE DEVELOPMENT OF INSTRUCTIONAL UNITS FOR ADULT AND YOUNG FARMER EDUCATION. THE PROJECT STAFF HELD A TWO-DAY WORKSHOP ON THE DEVELOPMENT OF INSTRUCTIONAL UNITS FOR ADULT AND YOUNG FARMER EDUCATION FOR 20 VOCATIONAL AGRICULTURE TEACHERS. THE UNIT TOPICS WERE ASSIGNED ACCORDING TO THE SUBSTANTIVE EXPERTISE OF THE TEACHERS. CURRICULUM MATERIALS RELATED TO EACH TOPIC WERE REVIEWED BY THE TEACHERS. ADDITIONAL COPIES OF MATERIALS NEEDED FOR THE DEVELOPMENT OF THE UNITS WERE SECURED FOR THE TEACHER. THE PROJECT STAFF PRESENTED THE FORMAT TO BE FOLLOWED TO THE TEACHERS AND EXPLAINED THE INTRICACIES OF FOLLOWING THE OUTLINED PROCEDURE. THE TEACHERS DEVELOPED EXAMPLES. THEIR PRELIMINARY WORK WAS REVIEWED BY THE PROJECT STAFF. THESE EXAMPLES SERVED AS GUIDES IN COMPLETING THE ASSIGNMENT.

TWENTY-TWO FIELD-TESTED INSTRUCTIONAL UNITS WERE DEVELOPED FOR USE IN ADULT AND YOUNG FARMER EDUCATION BY VOCATIONAL AGRICULTURE TEACHERS IN OHIO. THE TEACHERS SUBMITTED AN INITIAL DRAFT OF EACH UNIT TO THE PROJECT COMMITTEE FOR EDITING, ILLUSTRATING AND FINAL PREPARATION FOR FIELD-TESTING. UPON COMPLETION OF THE INITIAL DRAFT, THE UNITS WERE DISTRIBUTED TO SELECTED TEACHERS WHO TAUGHT THE UNITS AND RECORDED SUGGESTED CHANGES. THESE CHANGES WERE INCORPORATED INTO THE UNITS PRIOR TO FINAL EDITING AND PRINTING.

APPROXIMATELY 350 TEACHERS OF PRODUCTION AGRICULTURE AND FARM MANAGEMENT WERE TRAINED IN THE UTILIZATION OF THE INSTRUCTIONAL UNITS AT THE OHIO VOCATIONAL AGRICULTURE TEACHERS CONFERENCE ON JULY 8, 1975. SELECTED TEACHERS WHO PARTICIPATED IN THE PROJECT PROVIDED INSTRUCTION ON THE UTILIZATION OF THE UNITS IN A STEP BY STEP PROCEDURE. THE FLEXIBILITY OF THE UNITS WAS STRESSED TO SHOW THE ADAPTABILITY OF THE UNITS TO THE VARIOUS NEEDS IN COMMUNITIES ACROSS THE STATE. THE TEACHERS WERE PRESENTED COPIES OF THE MATERIAL FOR USE IN THEIR INSTRUCTIONAL PROGRAMS DURING THE 1975-76 SCHOOL YEAR.

PARTICIPANTS:

TWENTY VOCATIONAL AGRICULTURE TEACHERS WERE SELECTED TO PARTICIPATE IN DEVELOPING THE INSTRUCTIONAL UNITS. THEY WERE SELECTED FOR THEIR EXPERTISE IN THE TOPICAL AREAS, THE QUALITY OF THEIR ADULT EDUCATION PROGRAM AND DESIRE TO IMPROVE THEIR INSTRUCTION IN ADULT EDUCATION. ALL PRODUCTION AGRICULTURE AND FARM MANAGEMENT INSTRUCTORS ATTENDING THE SUMMER CONFERENCE PARTICIPATED IN THE SESSION ON UTILIZATION OF THE UNITS.

Evaluation Procedures:

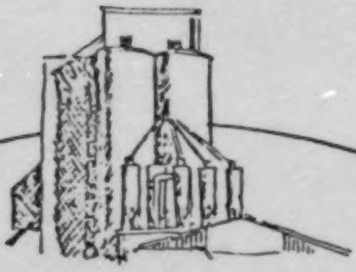
The instructional units were extensively reviewed by individual teachers and project staff members prior to undergoing field-testing. The units were field-tested by project participants and by non-participating teachers. Both groups of teachers taught the units and suggested changes in the units. Based on these recommendations the project staff completed the final draft for editing and printing.

Impact on Educational Delivery System:

The development of these units will result in more informed and organized instruction in adult education in vocational agriculture. The publications which were produced will serve as examples for use by teacher educators in pre-service and in-service education programs. Furthermore, local teachers will be able to adapt this format and prepare additional units for future adult education classes.

Materials Developed:

Resource Units for Adult Education Classes in Agriculture is a series of 22 instructional units in adult education. Units were developed in the following agriculture areas of instruction: Corn and Soybean Production, Agriculture Mechanics, Swine Production, Farm Management, and Horticulture. The materials are available from the Department of Agricultural Education, The Ohio State University, Columbus, Ohio 43210. A copy is shown as an appendix to this report.



A BUSINESS WITHOUT RECORDS
A CLOCK WITHOUT HANDS

RESOURCE UNITS FOR ADULT EDUCATION CLASSES IN AGRICULTURE

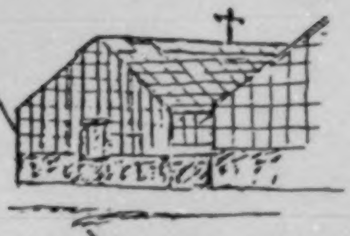


TABLE OF CONTENTS

Unit No.	Unit Title	Author of Unit
1	Producing High Corn Yields	Odell Miller
2	Producing High Soybean Yields	Clair Jones
3	Weed Control in Soybeans	Bob Stone
4	Corn and Soybean Harvest Losses	Jim Moorman
5	Big Package Haymaking	Bill Massey
6	Service and Adjustment of Planting Equipment	John G. Roberts
7	Machinery Selection and Practice to Reduce Tillage of Row Crops	Ray Clevenger
8, 9, 10, 11	Servicing the Hydraulic System	Wayne Longbrake
12	Planning the Farm Service Center	Wayne Longbrake
13	Planning a Confinement Hog Feeding Operation	Wilbur Frantom
14	Feeding and Management of the Gestating Sow	Howard Siegrist
15	Economic Aspects of Swine Production for 1974-75	Adrian E. Roberts
16, 17, 18	What Can You Afford to Pay for Land	Thomas Kremer
19	Management of Operating Costs for Corn and Soybean Crop Production	Carmen Cummins
20	Planning and Growing a Home Vegetable Garden	Mike Hampson
21	Home Patio Construction	Monroe Harbage
22	Grain Drying and Storage Alternatives	James D. Cooper

Adult Unit No. 1

PRODUCING HIGH CORN YIELDS

A Resource Unit For Adult Education
Classes in Agriculture

Developed by
Odell Miller

Edited by
J. David McCracken

Department of Agricultural Education
College of Agriculture and Home Economics
The Ohio State University
Columbus, Ohio 43210

1975

PREFACE

THIS RESOURCE UNIT WAS DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U. S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN
ASSISTANT PROFESSOR

L. H. NEWCOMB
ASSISTANT PROFESSOR

TABLE OF CONTENTS

	PAGE
PREFACE	III
INTRODUCTION	1
STATE SITUATION	3
LOCAL SITUATION	3
OBJECTIVES	3
REFERENCES	3
NEEDED AV EQUIPMENT	4
ALTERNATIVE INTEREST APPROACHES	4
QUESTIONS TO BE ANSWERED	4
LEARNING ACTIVITIES	5
TO SUMMARIZE (NOTE TO TEACHER)	6
APPLICATION	7
APPENDIX A: CONTENT SUMMARY	8
APPENDIX B: INSTRUCTIONAL MATERIALS	14

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATABLE TO THE LOCAL COMMUNITY.

PRODUCING HIGH CORN YIELDS

STATE SITUATION

ACCORDING TO OHIO STATE UNIVERSITY'S EXTENSION AGRONOMY GUIDE, THE AVERAGE CORN YIELD IN OHIO HAS INCREASED ABOUT ONE BUSHEL PER ACRE PER YEAR IN RECENT YEARS. IN 1973, THE STATE AVERAGE WAS 92 BUSHELS. IN 1974, THE AVERAGE YEILD DROPPED BECAUSE OF ADVERSE WEATHER CONDITIONS. WITH RECOMMENDED PRODUCTION PRACTICES, THE AVERAGE YIELD SHOULD EXCEED 115 BUSHELS PER ACRE, ACCORDING TO THE AGRONOMISTS. A FARMER CURRENTLY RAISING CORN YIELDING AT THE STATE AVERAGE WHO IS WILLING TO FOLLOW RECOMMENDED PRACTICES COULD, ACCORDING TO THE ABOVE INFORMATION, INCREASE PRODUCTION 23 BUSHELS PER ACRE. THIS WOULD RESULT IN ADDITIONAL INCOME OF $80.50 PER ACRE WITH CORN AT $3.50 PER BUSHEL.

LOCAL SITUATION

COMPARE COUNTY YIELD DATA WITH STATE YIELD DATA AND WITH YIELD DATA FROM O.S.U. RESEARCH STATIONS IN THE AREA. INTERVIEW WINNERS IN COUNTY YIELD CONTESTS AND IDENTIFY THEIR PRODUCTION PRACTICES AND YIELDS.

OBJECTIVES

THE ADULTS SHOULD BE ABLE TO:

1. DETERMINE OPTIMUM PLANTING DATES
2. SELECT HIGH-YIELDING HYBRIDS.
3. PLAN A CALENDARIZED PLANTING SCHEDULE.
4. PLAN FOR OPTIMUM PLANTING DEPTH.
5. SELECT CORRECT PLANTING RATES.
6. IDENTIFY FACTORS FAVORING A NARROW SPACING.

REFERENCES

ALDRICH, SAMUEL R. AND LENG, EARL R., MODERN CORN PRODUCTION, URBANA, ILL.: F&W PUBLISHING CORP., 1965.

1974-75 AGRONOMY GUIDE, COLUMBUS, OHIO: COOPERATIVE EXTENSION SERVICE, THE OHIO STATE UNIVERSITY, BULLETIN 472.

PRODUCING HIGH CORN YIELDS, URBANA, ILLINOIS: UNIVERSITY OF ILLINOIS, COLLEGE OF AGRICULTURE, VOCATIONAL AGRICULTURE SERVICE, VAS 4039A.

NEEDED AV EQUIPMENT

CHALKBOARD, SLIDE PROJECTOR, OVERHEAD PROJECTOR.

ALTERNATIVE INTEREST APPROACHES

ALTERNATIVE A. HOLD GROUP DISCUSSION ON PLANTING DATES, PLANT POPULATION AND YIELD. USE CHALKBOARD. DISCUSS WHY THE DIFFERENCES -- HOW THIS CHANGED OVER THE YEARS?

ALTERANTIVE B. USE SLIDES OF LOCAL FIELDS THAT WERE PLANTED EARLY AND LATE. SAME WITH POPULATION STANDS. (THE TEACHER WILL PROBABLY HAVE TO TAKE SLIDES.)

ALTERNATIVE C. HOLD MEETING AT MEMBER'S FARM AND CHECK POPULATION STANDS.

ALTERNATIVE D. USE THE OHIO RESEARCH ON CORN PERFORMANCE TESTS AT THE DIFFERENT LOCATIONS AROUND THE STATE.

ALTERNATIVE E. USE TRANSPARENCY T-1 TO ILLUSTRATE INCREASES IN YIELD THROUGH APPLICATION OF APPROVED PRACTICES.

QUESTIONS TO BE ANSWERED

1. WHAT ARE THE OPTIMUM PLANTING DATES IN THIS COMMUNITY?
   A. WHAT DOES RESEARCH SHOW AS THE OPTIMUM RANGE OF PLANTING DATES?
   B. WHY IS HIGH YIELD GENERALLY ASSOCIATED WITH EARLY PLANTING?
   C. WHAT IS THE RELATIONSHIP BETWEEN SOIL TEMPERATURE AND PLANTING DATE?
2. WHAT FACTORS SHOULD BE CONSIDERED IN SELECTING A CORN HYBRID?
3. WHAT MIGHT BE A POSSIBLE "CALENDARIZED" PLANTING SCHEDULE IN YOUR COMMUNITY?
4. WHAT PLANTING DEPTH IS MOST IDEAL FOR CORN?
5. WHAT PLANTING RATE SHOULD BE USED?
   A. WHAT FACTORS INFLUENCE PLANT POPULATION?
   B. WHAT IS THE RELATIONSHIP BETWEEN POPULATION AND YIELD?
   C. WHAT POPULATION STAND LOSS IS NORMAL FROM PLANTING TO HARVEST?
6. WHY ARE MANY FARMERS NARROWING CORN ROW WIDTH?

Learning Activities

1. What are the optimum planting dates in this community?

Discuss transparency T-2: "Planting Dates and Effects...."

Discuss the value of early planting as it relates to tasseling. Show transparency T-3: "Total Daylight During the 53 Days Following Silking," to demonstrate the advantage of early silking in terms of maximum use of sunlight.

Open discussion of optimum soil temperatures by showing transparency T-4: "Optimum Soil Temperature for Planting Corn." Note that the recommended temperature range for Ohio is 55-65°F. Indicate this on the transparency. Continue discussion by pointing out the expected difficulties with higher or lower temperature ranges. Note these on the transparency as desired.

2. What factors should be considered in selecting a corn hybrid?

Have farmer participants discuss the results they want (early harvest, high yield, etc.) and then compare these with the type of corn hybrids most likely to produce these results. (Use of a chalkboard chart may help to illustrate this.)

(Chalkboard Chart)

Type of Hybrid	Early Harvest	High Yield	Disease Resistant

Farmers may relate their own experiences with various hybrids. But, if possible, obtain performance tests records on hybrids under study by the Ohio Extension Service.

3. What might be a possible "calendarized" planting schedule in this community?

Discuss Transparency T-5: "Corn Calendarized Program." Interest questions in this area might relate to the demands on a farmer's time during peak work times at planting and harvest.

4. What planting depth is most ideal for corn?

Have class members discuss factors which influence planting depth. During the discussion, complete a chalkboard chart with factors such as the following:

(Chalkboard Chart)

Seed Depth	Planting Dates	Soil Moisture	Evaporation Rate
1-1 1/2"	April	Moist	Low
2"	May	Drier	Increasing

USE TRANSPARENCY T-6 TO SHOW THE EFFECTS OF DIFFERENT PLANTING DEPTHS ON AVERAGE YIELD. MORE SHALLOW PLANTED CORN GAVE THE BEST YIELDS IN ALL TESTS OVER A 22 YEAR TESTING PERIOD. THIS IS EXPLAINED BY GREATER USE OF FOOD RESERVE IN THE DEEPER PLANTED SEED TO PUSH THE SHOOT THROUGH THE SOIL TO THE SURFACE. NOTICE THAT THE DEPTH OF PLANTING HAS NO EFFECT ON THE DEPTH OF PERMANENT ROOT GROWTH. ALL PERMANENT ROOTS GROW OUT FROM THE STALK JUST BELOW THE SURFACE OF THE SOIL, WHETHER THE SEED IS PLANTED ONE OR FIVE INCHES DEEP.

5. WHAT PLANTING RATE SHOULD BE USED?

DISCUSS TRANSPARENCY T-7: "VARYING SEED DROP AND PLANT POPULATION."

HAVE CLASS MEMBERS CONSIDER ADDITIONAL FACTORS AFFECTING CORN POPULATION SUCH AS SOIL MOISTURE AND FERTILIZER.

6. WHY ARE MANY FARMERS NARROWING CORN ROW WIDTH?

SHOW TRANSPARENCY T-8: "CORN ROW WIDTH AND RESULTING YIELD." THEN, DISCUSS CONDITIONS SUCH AS USE OF SUNLIGHT, MOISTURE, HIGHER POPULATION AND HUMIDITY LEVELS.

TO SUMMARIZE (NOTE TO TEACHER)

CORN PRODUCTION IN THE FUTURE IS A HAZARDOUS UNDERTAKING. PLANT POPULATIONS WILL CONTINUE TO CLIMB RAPIDLY INTO THE 20,000 TO 28,000 RANGE AS MORE HYBRIDS BECOME AVAILABLE THAT CAN WITHSTAND HIGH POPULATIONS. EARLY PLANTING WHICH PRODUCES SHORTER PLANTS AND EARLIER HARVESTING WILL HELP TO ACCELERATE THIS SHIFT.

ONE OF THE LIMITING FACTORS IN CORN PRODUCTION IS THE LIGHT-TRAPPING EFFICIENCY OF THE CORN PLANT. DURING THE GROWING SEASON ABOUT 3 PERCENT OF THE LIGHT ENERGY AVAILABLE TO AN ACRE OF CORN IS UTILIZED. SCIENTISTS ARE ATTEMPTING TO ACHIEVE A BREAKTHROUGH IN TECHNIQUES TO IMPROVE THE EFFICIENCY OF THE CORN PLANT. PRESENTLY CORN PRODUCERS WILL HAVE TO BE SATISFIED WITH THE EFFICIENCY THEY CAN GAIN THROUGH:

1. EARLY PLANTING. (CORN THAT SILKS JULY 1 HAS 57.7 MORE HOURS OF SUNLIGHT DURING THE 53 DAYS AFTER SILKING THAN A CROP THAT SILKS AUGUST 1.)
2. HIGH POPULATIONS WHICH PRODUCE MORE LEAF SURFACE TO INTERCEPT THE SUN'S ENERGY.
3. NARROW ROWS TO REDUCE THE AMOUNT PLANTS SHADE EACH OTHER.

WATER IN THE SOIL AT PLANTING TIME PLUS NORMAL OR EVEN SLIGHTLY LESS THAN NORMAL RAINFALL DURING THE GROWING SEASON IS ADEQUATE FOR MAXIMUM CORN YIELDS IF IT CAN BE STORED IN THE SOIL AND IT IS NOT LOST THROUGH EVAPORATION AND RUNOFF. FARMERS MAY MAXIMIZE THE EFFICIENCY OF WATER UTILIZATION BY EARLY PLANTING, NARROW ROWS, HIGH FERTILITY TO INCREASE ROOTING DEPTH, REDUCED TILLAGE TO IMPROVE SURFACE STRUCTURE AND BETTER WEED CONTROL.

APPLICATION

A. PRODUCING HIGH CORN YIELDS (HANDOUT)

B. USE SUPERVISORY VISITS TO EVALUATE APPLICATION OF APPROVED PRACTICES (T-9).

C. GROW TEST PLOTS ON FARMS IN THE COMMUNITY TO DETERMINE:

1. OPTIMUM PLANTING DATES
2. HIGH YIELDING HYBRIDS
3. ADVANTAGES AND DISADVANTAGES OF "CALENDARIZATION"
4. IDEAL PLANTING DEPTH
5. RATE OF PLANTING
6. OPTIMUM ROW WIDTH AND SPACING.

APPENDIX A

CONTENT SUMMARY

1. PLANTING DATES
2. SOIL TEMPERATURE
3. CALENDARIZING
4. DEPTH OF PLANTING
5. CORN POPULATION
6. ROW WIDTHS
7. CORN HYBRIDS

Planting Dates

Long-term research conducted by the Ohio Cooperative Extension Service at Wooster, Ohio, shows that the highest corn yields have been obtained from a May 7 date of planting, and lower yields were obtained when planting was earlier or later. Research workers indicated that moving south from Wooster, the season changes on the average of one day earlier for each 10 miles. Corn planted earlier than normal still produced adequate stands and yields, but yields declined rapidly when planting was done after the optimum date. The moisture content of the grain increased and the test weight decreased with later dates of planting. It appears that the range of optimum planting dates in Ohio is from April 23 to May 10.

There are several reasons to plant early. The most important being that the corn plant develops better and has a higher yield potential when the vegetative period of its development falls in the cooler, more moist weather of May and early June. Also, earlier planting tends to place tasseling and silking ahead of the greatest risk of moisture and heat stress damage. Early planted fields have a deeper root system by late June or early July and thus are more likely to have subsoil water available to them when the summer drought occurs.

Corn planted early is shorter and has lower ear height and less lodging, thus allowing one to safely increase the plant population. Finally, early planting of properly selected hybrids leads to earlier maturity, which results in more efficient harvesting, less chance of early frost damage, and less danger of harvest loss due to bad weather. Another favorable factor in the trend to plant earlier is the high quality of hybrids with seed vigor which are available. Today, hybrids are bred for resistance to soil-borne disease and cold; the seed vigor enables the seed to germinate even when conditions are unfavorable.

Planting corn early is one way to increase the odds of getting more favorable weather for tasseling -- the most critical time in the life of the corn plant. The closer to June 22 tasseling, pollination and ear filling occur, the more daylight the corn will have and thus, the most favorable light conditions.

If the corn tassels in early July, it will have a better chance of receiving the needed moisture and a shorter period of hot weather to accelerate surface evaporation. Early planting coincides with early shading, which reduces soil water evaporation. The peak energy demand is at the tasseling stage and immediately thereafter. Sunlight provides the energy to continue the corn plant factory operation. Corn tasseling July 1 will have approximately 58 more hours of sunlight energy than corn tasseling August 1. Hence early planted corn will receive more available moisture and energy to meet the needs of the corn plant to produce high yields.

SOIL TEMPERATURE

SOIL TEMPERATURE IS CRITICAL IN THE SEED GERMINATION PROCESS. UNDER OPTIMUM CONDITIONS, CORN SHOULD BE PLANTED WHEN THE SOIL TEMPERATURE RANGES BETWEEN 55 TO 65 DEGREES FAHRENHEIT. BY THIS TIME, SOIL TEMPERATURE IS HIGH ENOUGH TO PERMIT PROMPT GERMINATION AND THE SEEDLINGS WILL BE ABOVE GROUND IN 7 TO 10 DAYS AFTER PLANTING. HOWEVER, IF THE SOIL TEMPERATURE IS 50 DEGREES AND RISING RAPIDLY, PLANTING IS SAFE BECAUSE THE SOIL WILL SOON BE WARM ENOUGH FOR GERMINATION. IT IS WORTHWHILE TO REMEMBER THAT WARM WEATHER AND HIGH SOIL TEMPERATURES COME TO THE CORN BELT QUICKLY, SO AN IMPORTANT FACTOR TO CONSIDER IS THE WEATHER TREND. OTHER CONDITIONS THAT ARE ESSENTIAL TO GOOD GERMINATION ARE SUFFICIENT AIR AND MOISTURE. CURRENT RESEARCH INDICATES A LOSS OF ONE BUSHEL PER DAY PER ACRE FOR EACH DAY PLANTING IS DELAYED AFTER THE OPTIMUM PLANTING DATE FOR AN AREA.

CALENDARIZING

MOST CORN GROWERS FIND IT IMPOSSIBLE TO PLANT THEIR CROP IN ONE OR TWO DAYS. A PLANNED SCHEDULING OF PLANTING DATES HAS BEEN DEVELOPED AND IS KNOWN AS CALENDARIZATION. IT IS DESIGNED TO SPREAD OUT THE TIME AND LABOR OF HARVESTING. IT ALSO REDUCES THE RISK OF HOT, DRY WEATHER SINCE EARLY PLANTINGS SILK AS MUCH AS TEN DAYS APART.

UNDER A CALENDARIZED SYSTEM, THE EARLIEST HYBRIDS ARE PLANTED FIRST AND THE FULL-SEASON HYBRIDS LAST. PLANTING THE EARLIEST HYBRID FIRST INSURES A WIDE SPREAD IN POLLINATION TIME, WITH THE EARLIER HYBRIDS TASSELING AND SILKING 10 TO 20 DAYS BEFORE THE FULL-SEASON TYPES. CALENDARIZATION WILL SPREAD THE WORK LOAD OF BOTH PLANTING AND HARVESTING OVER A LONGER TIME, AND REDUCE PEAK LOADS CONSIDERABLY.

PLANTING AN EARLY SEASON HYBRID FIRST IS SOUND FOR ANOTHER IMPORTANT REASON. MOST OF THESE HYBRIDS HAVE BEEN DEVELOPED FOR NORTHERN CORN GROWING AREAS WHERE SOILS ARE COLD AND GROWING CONDITIONS UNFAVORABLE IN THE EARLY PART OF THE SEASON. THEREFORE, THESE HYBRIDS ARE SUITED TO EARLY PLANTING. (SEE TRANSPARENCY #5.)

DEPTH OF PLANTING

IN THE 1966 AND 1967 CORN PLANTING SEASONS, WITH COLD SOILS, ADEQUATE MOISTURE, AND LONG-RANGE WEATHER PREDICTIONS FOR BELOW-NORMAL TEMPERATURES, CORN IN MANY FIELDS WAS PLANTED TOO DEEP (2 TO 4 INCHES). IT IS IMPORTANT TO ADJUST PLANTING DEPTH FOR WEATHER PREDICTIONS, SOIL CONDITIONS, AND SEED SIZE. GENERALLY A 2-INCH PLANTING DEPTH IS BEST FOR MEDIUM-SIZE SEED WITH NORMAL TEMPERATURE AND MOISTURE CONDITIONS. IN APRIL, WHEN THE SOIL IS MOIST AND THE EVAPORATION RATE IS LOW, CORN

SHOULD BE PLANTED NO DEEPER THAN 1 TO 1 1/2 INCHES. AS THE SEASON ADVANCES AND EVAPORATION RATES INCREASE, SEED PRESS-WHEELS MAY BE USED TO INSURE GOOD SEED-TO-SOIL CONTACT. THE SEED PRESS-WHEELS ARE PREFERRED TO PLANTING DEEPER THAN 2 INCHES.

A PLANTING DEPTH OF 1 1/2 INCHES IS IMPORTANT FOR FROST PROTECTION IN EARLY PLANTING. PLANTING AT THIS DEPTH ALLOWS THE GROWING POINT OF THE PLANT TO DEVELOP BELOW GROUND LEVEL. HOWEVER PLANTING DEEPER THAN 1 1/2 INCHES DOES NOT ALLOW THE GROWING POINT TO DEVELOP FARTHER UNDERGROUND. WHEN PLANTING IN EXCESS OF THE RECOMMENDED DEPTH, THE GROWTH OF THE HYPOCOTYL IS INCREASED; THE GROWING POINT DEVELOPS AT ABOUT THE SAME DEPTH (1 1/2 INCHES). PLANTING DEEPER WILL ALSO EFFECT THE RATE OF POPULATION BECAUSE OF THE INCREASED STRESS PLACED ON THE SEED, DUE TO THE EXTRA GROWING DISTANCE BEFORE EMERGENCE.

CORN POPULATION

PLANT POPULATION RECOMMENDATIONS ARE BASED ON PLANT COUNT AT HARVEST TIME. GENERALLY, THERE IS A DECREASE OF 10 TO 25 PERCENT FROM THE PLANTER MANUAL SETTING FOR SEED DROP PER ACRE AND THE RESULTING STAND OF CORN AT HARVEST. HENCE, EACH PRODUCER SHOULD CALIBRATE THE PLANTER BEFORE OPERATION. PRODUCERS PLANTING POPULATIONS ABOVE 20,000 PLANTS PER ACRE SHOULD ADJUST THE PLANTER TO DROP 10 PERCENT MORE SEEDS THAN REQUIRED FOR THE DESIRED HARVEST STAND. FARMERS ARE ENCOURAGED TO INCREASE THEIR SEED DROP BY 2,000 TO 3,000 PER ACRE WHEN PLANTING EARLY. THERE ARE THREE REASONS FOR THIS: 1) SEEDLING MORTALITY IS A LITTLE GREATER, 2) PLANTS ARE SHORTER AND THEY LODGE LESS, AND 3) MOISTURE SUPPLY IS MORE LIKELY TO BE ADEQUATE.

THE TREND IN MODERN CORN PRODUCTION IS TOWARDS SELECTING HYBRIDS WHICH WILL TOLERATE HIGH POPULATION WITHOUT LODGING OR GOING BARREN. RESEARCH WORKERS HAVE KNOWN FOR MANY YEARS, AND LEADING FARMERS NOW REALIZE, THAT YIELDS OF WELL FERTILIZED CORN DO NOT FALL OFF VERY SHARPLY WHEN PLANT POPULATION IS ABOVE THE OPTIMUM, EVEN IN DRY YEARS. IN GENERAL, IT HAS BEEN FOUND THAT THE LARGEST INCREASES IN YIELDS ARE LIKELY TO BE WITH HIGH POPULATIONS WHERE THE PRODUCER IS FERTILIZING AND MANAGING FOR TOP YIELD AND DURING YEARS WHEN THERE IS PLENTY OF MOISTURE AVAILABLE.

ROW WIDTHS

THE YIELD INCREASE FROM REDUCING THE ROW WIDTH FROM 40 TO 20 INCHES WILL AVERAGE 10 BUSHELS PER ACRE. OHIO DATA OBTAINED OVER A 10-YEAR PERIOD INDICATES THAT EXPECTED YIELD INCREASE FROM REDUCING ROW WIDTH IS ABOUT 1/2 BUSHEL PER ACRE PER INCH DECREASE IN ROW WIDTH. NARROW ROWS MAKE MORE EFFICIENT USE OF THE AVAILABLE SUNLIGHT AND ALSO SHADE THE SURFACE SOIL MORE COMPLETELY DURING THE EARLY PART OF THE SEASON WHILE THE SOIL IS MOIST.

The combination of single plants in narrow rows and high populations provide shade to the soil and thus reduce surface moisture evaporation. Since more leaf area is exposed to radiation from the sun, transpiration loss is greater. The more uniformily the plants are placed, the better - as long as the surface soil is moist. This maximizes photosynthesis and the proportion of water that is utilized in the growth processes rather than lost through evaporation. The increased efficiency in the use of sunlight for photosynthesis and improved water use when the soil surface is moist, more than offset any disadvantage when the soil is dry - especially in the early part of the season and after each rain.

Before trying narrow row widths farmers should consider the hybrids they are growing, suitability of their machinery for the row width and the extra time needed to plant, cultivate and harvest. However, the yield increase is a sound reason to tool up for narrow rows when old equipment needs replacing.

Corn Hybrids

Whether a farmer wants to use his crop for silage or grain, the right maturity is important. Farmers need to select hybrids which will regularly reach or be near physiological maturity before frost and which will dry down to safe storage moisture levels before harvest. The Ohio Agronomy Guide is the best source of this information.

Everyone wants high-yielding corn, but every experienced corn grower knows that some hybrids yield more under his soil conditions than others. Yield is not a simply-inherited, easily predicted characteristic. Many farmers pick a hybrid because it has big ears or several ears per plant and automatically assume that it will be the highest yielder. However, a hybrid will not always have the same yield from one year to the next. The best procedure is to check performance test records for several years which are available from the Ohio Cooperative Extension Service.

Good standability of the corn plant is absolutely essential. Hybrids which do not stand until harvest cause considerable yield loss. Breeders are now placing considerable emphasis on stalk and root strength in developing new hybrids. When aiming for high yields and high population, the farmer must be sure that the hybrids he chooses have proven standability.

Another factor to be considered is diseases that attack the corn plant. Resistance to specific diseases is a very valuable characteristic of a hybrid; it needs to be able to shrug off a major disease attack.

The performance of a hybrid is not the same under all conditions. A good hybrid will have adaptability, thus a hybrid should yield and

STAND RELATIVELY WELL IN BOTH FAVORABLE AND UNFAVORABLE CONDITIONS. HOWEVER, THERE ARE NOT MANY HYBRIDS THAT HAVE THIS CAPACITY. IN GENERAL, A HYBRID WHICH WILL PERFORM WELL UNDER NEARLY ALL CONDITIONS SHOULD BE PREFERRED TO ONE WHICH IS TOP-YIELDING ONE YEAR, VERY LOW THE NEXT, EVEN IF THE AVERAGE PERFORMANCE OF THE HYBRID OVER A PERIOD OF TIME IS THE SAME.

APPENDIX B

INSTRUCTIONAL MATERIALS

HANDOUT

H-1: HOW TO GROW CONTEST-WINNING YIELDS

TRANSPARENCIES

T-1: FACTORS CONTRIBUTING TO YEARLY INCREASES IN YIELDS.

T-2: PLANTING DATES AND EFFECTS ON MOISTURE, TEST WEIGHT, AND YIELD OF CORN GRAIN, COLUMBUS. (PIONEER BRAND 3369A)

T-3: TOTAL DAYLIGHT DURING THE 53 DAYS FOLLOWING SILKING

T-4: "OPTIMUM SOIL TEMPERATURE FOR PLANTING CORN."

T-5: CORN CALENDARIZED PROGRAM

T-6: DEPTH OF PLANTING EFFECTS ON YIELDS

T-7: VARYING SEED DROP AND PLANT POPULATION

T-8: CORN ROW WIDTH AND RESULTING YIELD (OHIO, 1957-67)

T-9: APPROVED PRACTICES

HOW TO GROW CONTEST-WINNING YIELDS[1]

EVERY YEAR FARMERS ASK FOR A PRESCRIPTION THAT WILL GROW 150 TO 250 BUSHELS OF CORN PER ACRE WITHOUT COST CONSIDERATION. THE FOLLOWING SUGGESTIONS ARE TAKEN FROM AN "AGRONOMY FACT SHEET" PREPARED BY S. R. ALDRICH AND D. E. ALEXANDER, UNIVERSITY OF ILLINOIS:

1. SELECT A FIELD THAT HAS A DEEP, WELL-DRAINED SOIL WITH A HIGH MOISTURE-HOLDING CAPACITY. SILT LOAM SOILS WILL SUPPLY MORE AVAILABLE MOISTURE TO THE CROP THAN WILL EITHER FINE OR COARSE SOILS. A FIELD THAT WAS IN ALFALFA OR CLOVER LAST YEAR IS BEST, PROVIDED THERE HAS BEEN ENOUGH RAINFALL TO RECHARGE THE SUBSOIL WITH MOISTURE TO REPLACE THAT USED BY THE LEGUME LAST FALL.

2. RESOLVE TO DO EVERYTHING EXACTLY ON TIME EVEN IF IT MEANS NEGLECTING SOME OTHER FIELD. THE CORN IN THIS FIELD MUST BE PAMPERED.

3. SELECT A HYBRID THAT WILL STAND THICK PLANTING. MAXIMUM YIELDS ARE MOST LIKELY TO COME FROM THICKLY PLANTED PLOTS, 20,000 TO 28,000 PLANTS PER ACRE. THESE HIGH POPULATIONS PLACE A STRAIN ON THE PLANT THAT MOST HYBRIDS CAN'T TAKE. CONSULT THE RESEARCH MEN OF YOUR FAVORITE SEED PRODUCER AND FOLLOW THEIR DIRECTIONS AS TO HYBRID. YOU SHOULD PLANT 15 TO 20 PERCENT MORE KERNELS THAN THE NUMBER OF PLANTS DESIRED AT HARVEST. EVEN WITH THE BEST HYBRIDS, BE PREPARED FOR A DEGREE OF LODGING AND BARRENNESS, PARTICULARLY IF A DROUGHT STRIKES.

4. DON'T OVERWORK THE SEEDBED! RESEARCH DATA SHOWS THAT YOU CAN GET TOP YIELDS WITH REDUCED TILLAGE IF YOU HAVE A GOOD STAND. AIM FOR THE LEAST SEEDBED PREPARATION THAT WILL ASSURE THE STAND YOU WANT. AN OVERFINE SEEDBED MAY CRUST AND CAUSE RAINFALL TO RUN OFF IN MIDSUMMER WHEN YOUR CORN URGENTLY NEEDS IT.

5. PLANT IN NARROW ROWS (30 INCHES OR LESS) IF YOU HAVE THE EQUIPMENT FOR IT.

6. MAKE SURE THE PLANTS ALWAYS HAVE PLENTY OF NUTRIENTS. FORGET ABOUT FERTILIZER COST. PLOW DOWN OR KNIFE IN 150 TO 200 POUNDS OF ACTUAL NITROGEN. BROADCAST AND PLOW UNDER PHOSPHORUS AND POTASSIUM AS INDICATED BY SOIL TESTS. AT PLANTING TIME, APPLY ABOUT 20 POUNDS OF NITROGEN, 30 TO 40 POUNDS OF P_2O_5, AND 20 TO 30 POUNDS OF K_2O THROUGH A PLANTER EQUIPPED TO PLACE THE FERTILIZER 1 1/2 TO 2 INCHES TO THE SIDE AND SLIGHTLY BELOW THE SEED. SIDEDRESS 50 TO 100 POUNDS OF NITROGEN AT THE TIME OF THE LAST CULTIVATION. TO AVOID ROOT PRUNING, PLACE IT MIDWAY BETWEEN THE ROWS. IF POSSIBLE, ALSO APPLY 10 TO 20 TONS OF MANURE. APPLY MICRONUTRIENTS IF YOU FARM IN AN AREA WHERE THEY ARE KNOWN TO BE NEEDED.

7. TREAT THE SOIL WITH AN INSECTICIDE TO CONTROL INSECTS AND ASSURE A FULL STAND OF VIGOROUS YOUNG SEEDLINGS. SPRAY OR DUST TO CONTROL THE CORN BORER IF PRESENT.

8. CONTROL WEEDS COMPLETELY WITH A PRE-EMERGENCY SPRAY IN A BAND OVER THE ROW OR A ROTARY HOE FOLLOWED BY ONE OR TWO SHALLOW CULTIVATIONS.

---

[1] ALDRICH, SAMUEL R. AND LENG, EARL R., MODERN CORN PRODUCTION, URBANA, ILL.: F&W PUBLISHING CORP., 1965.

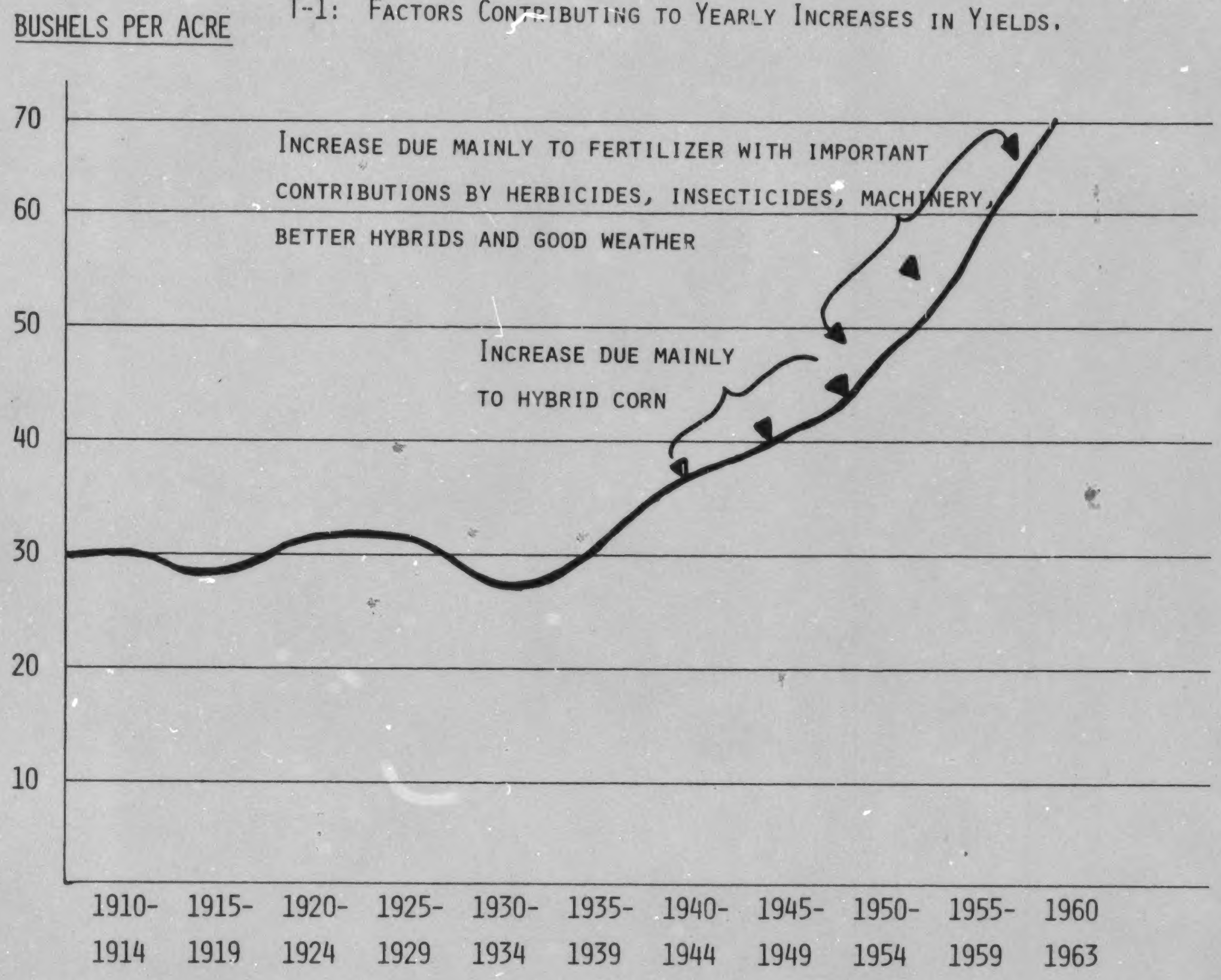
IF YOU CONTROL THE WEEDS BY SPRAYING AND A CRUST DEVELOPS, YOU HAD BETTER DO A SHALLOW CULTIVATION TO BREAK THE CRUST SO THAT RAIN CAN PENETRATE.

9. HARVEST CAREFULLY TO SAVE ALL OF THE CROP. PLAN TO PICK ONE OR TWO WEEKS EARLY, WHEN THE MOISTURE IN THE GRAIN IS ABOUT 30 PERCENT, TO REDUCE SHELLING AND AVOID LODGING WHICH INCREASES WITH THE AGE OF THE PLANTS. THIS HIGH-MOISTURE CORN MUST, OF COURSE, BE ARTIFICIALLY DRIED.

10. AT THIS POINT, EVERYTHING HAS BEEN DONE TO GROW A TERRIFIC YIELD. NOW ORDER AT LEAST AN INCH OF GENTLE RAIN EACH WEEK.

11. FINALLY, PREPARE TO ACCEPT EITHER SUCCESS OR FAILURE. WHEN YOU SHOOT FOR 150 TO 200 BUSHELS BY THESE TECHNIQUES, YOU ARE GAMBLING. GAMBLERS DON'T ALWAYS WIN. BUT EVEN IF YOU LOSE, YOU MAY ENJOY PLAYING THE GAME.

T-1: FACTORS CONTRIBUTING TO YEARLY INCREASES IN YIELDS.

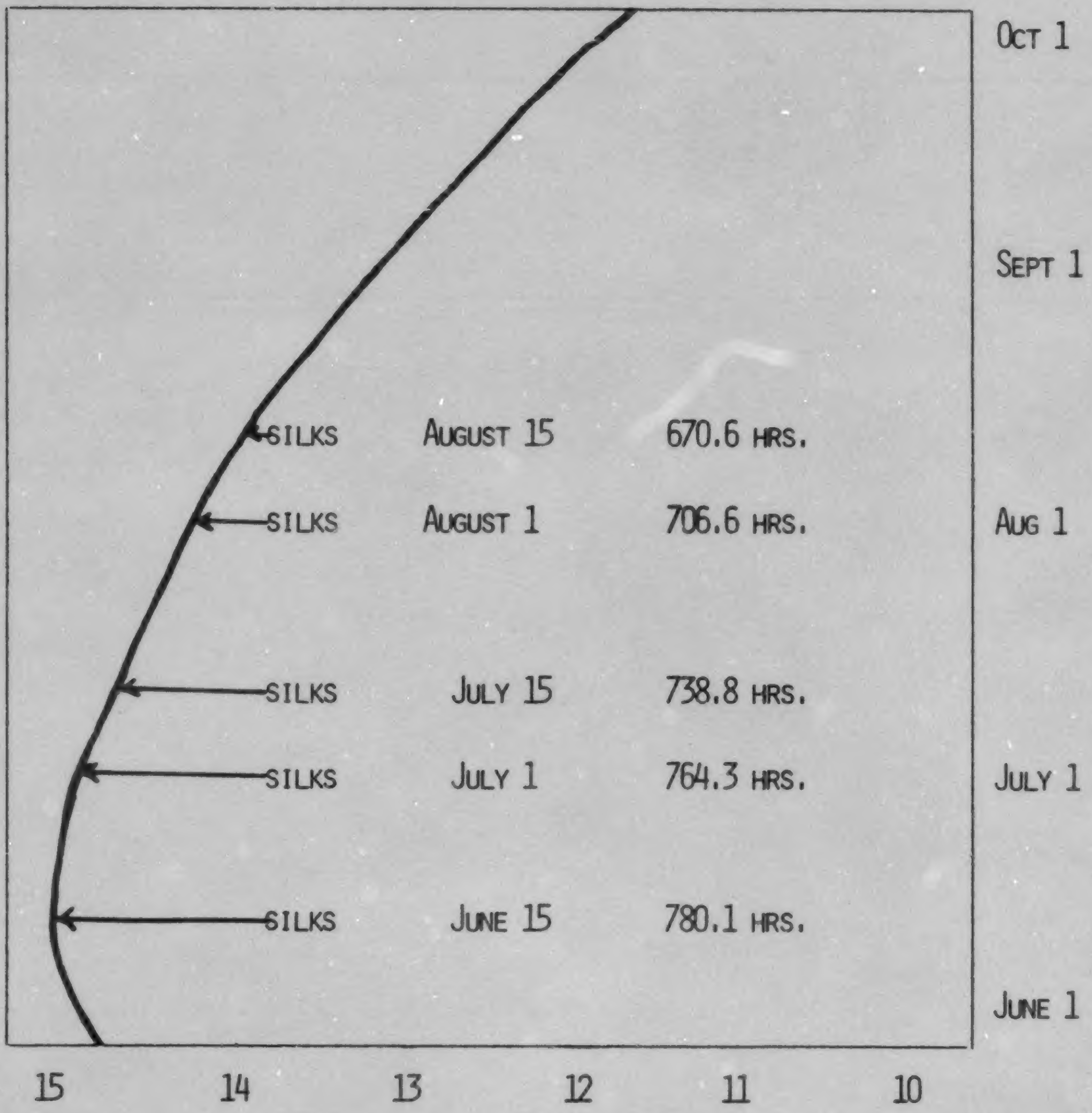


T-2: Planting Dates and Effects on Moisture, Test Weight, and Yield of Corn Grain, Columbus. (Pioneer Brand 3369A)

		Test	BU/A at 15 1/2%					
Date	Moisture	Wt.	1969	1970	1971	1972	1973	Average
Mar. 20 - 30	19.3	56	203	163	198	189	-	188
Apr. - 8	19.3	56	202	174	184	192	177	186
Apr. 9 - 15	19.3	56	194	160	188	195	172	182
Apr. 16 - 22	20.2	56	196	162	185	198	172	183
Apr. 23 - 29	20.8	55	187	-	169	190	180	182
Apr.-May 30 - 7	23.7	55	185	158	188	185	173	178
May 8 - 14	24.9	55	183	176	159	184	160	172
May 15 - 21	-	-	-	-	154	183	180	172
May 22 - 27	28.2	54	159	-	-	193	145	166
May-Jun 28 - 4	35.0	51	-	141	135	168	137	145
June 5 - 23	40.0	49	100	107	81	95	104	97

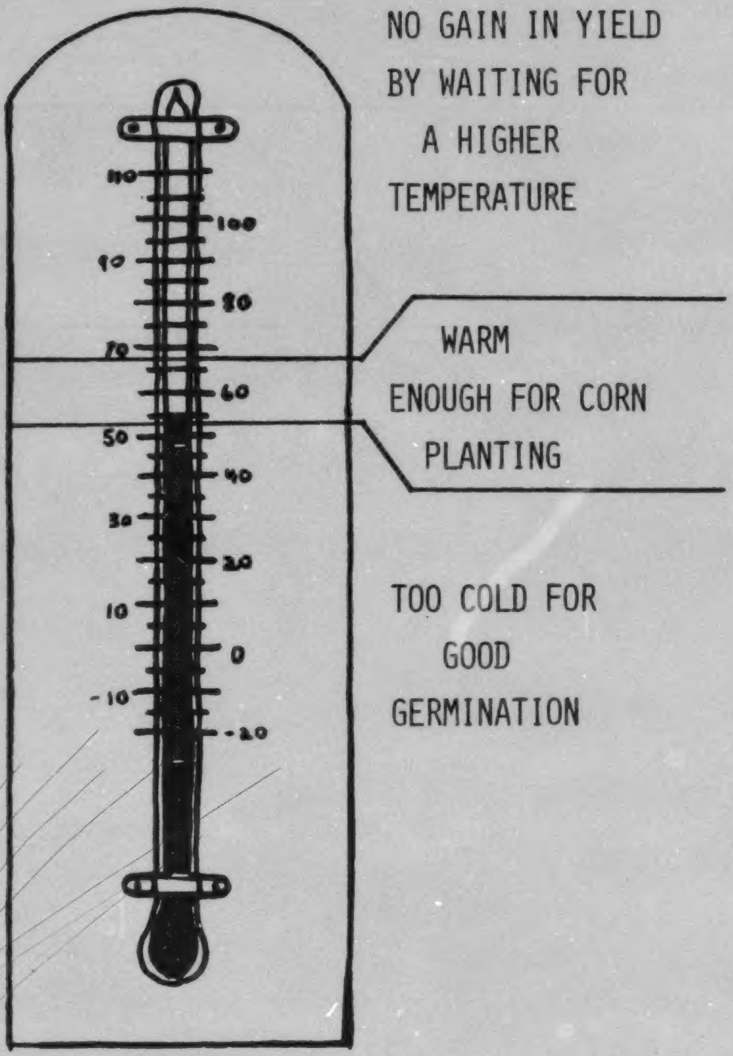
Source: 1974-75 Agronomy Guide.

T-3: TOTAL DAYLIGHT DURING THE 53 DAYS FOLLOWING SILKING



DAY LENGTH (SUNUP TO SUNSET) HOURS
AT URBANA, ILL.

T-4: "Optimum Soil Temperature for Planting Corn."


110
100
90
80
70
60
50
40
30
20
10
0
-10
-20

NO GAIN IN YIELD
BY WAITING FOR
A HIGHER
TEMPERATURE

WARM
ENOUGH FOR CORN
PLANTING

TOO COLD FOR
GOOD
GERMINATION

T-5: Corn Calendarized Program

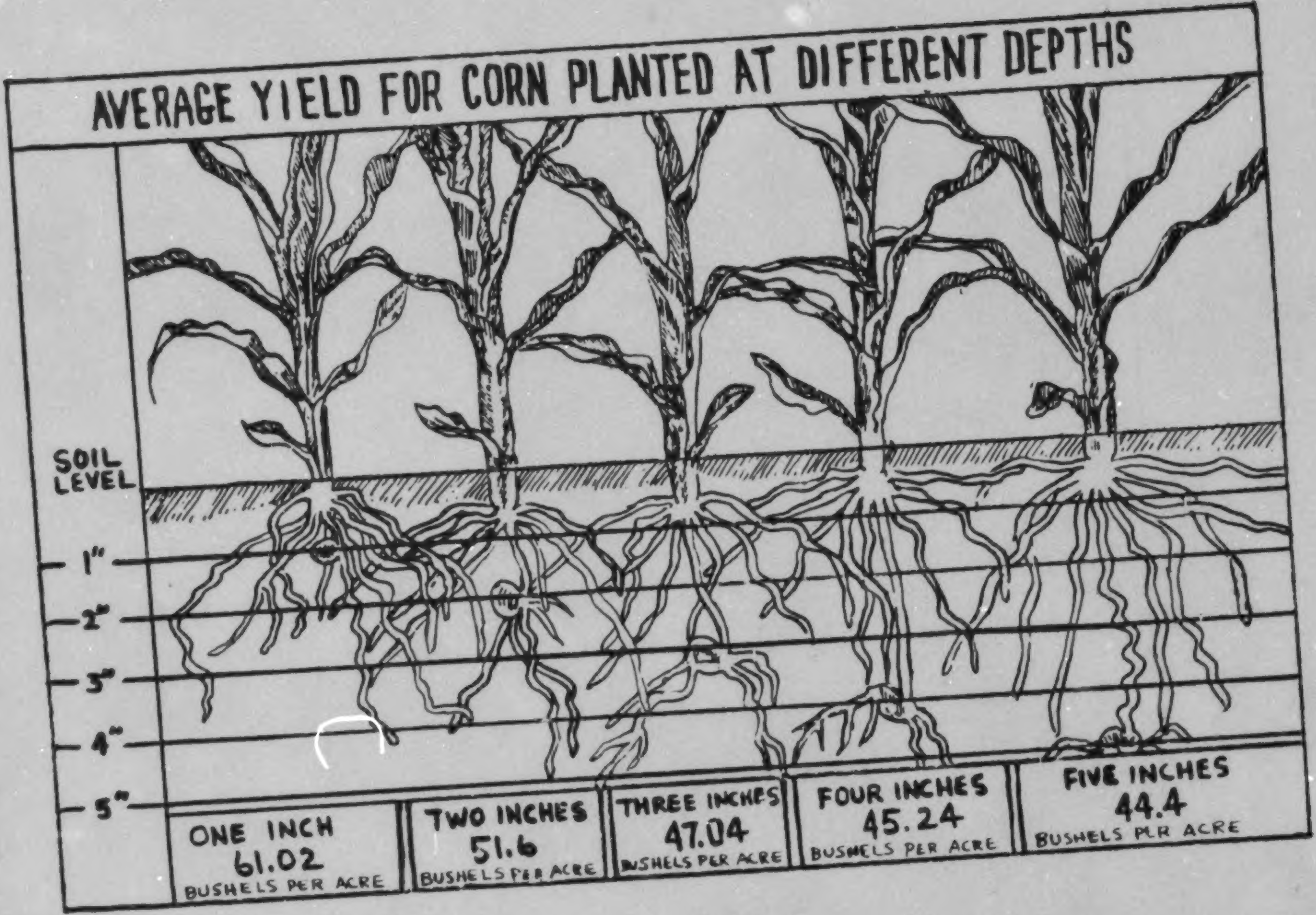
			AVERAGE DATE OF:				
CROP AND USE	ACRES	RELATIVE MATURITY	PLANTING	SEEDLING EMERGENCE	SILKING	MATURITY[A]	HARVEST[B]
Corn for grain	20	Early	May 3	May 20	July 20	Sept. 10	Oct. 5
Corn for silage	20	Midseason	May 5	May 21	July 25	Sept. 20	Sept. 20
Corn for grain	35	Midseason	May 9	May 23	July 26	Sept. 20	Oct. 15
Corn for grain	15	Full season	May 14	May 25	July 30	Sept. 25	Oct. 30
Soybeans	10	Full season	May 17	May 26	---	Sept. 25	Oct. 10

[A] Point of maximum dry matter accumulation, safe from frost, well dented, not yet dried down.

[B] Harvest date assumes a grain moisture content of 21 percent, usually a safe storage moisture for ear corn in 8-foot wide cribs.

Example of calendarized program for 100 crop acres. Allow 3 days on either side of dates shown for planting, emergence and silking and 5 days on either side of dates shown for maturity and harvest; this compensates for normal variations from north to south in the state and for varying field conditions. (From E. R. Duncan and H. E. Thompson, Iowa Farm Science.)

T-6: DEPTH OF PLANTING EFFECTS ON YIELDS

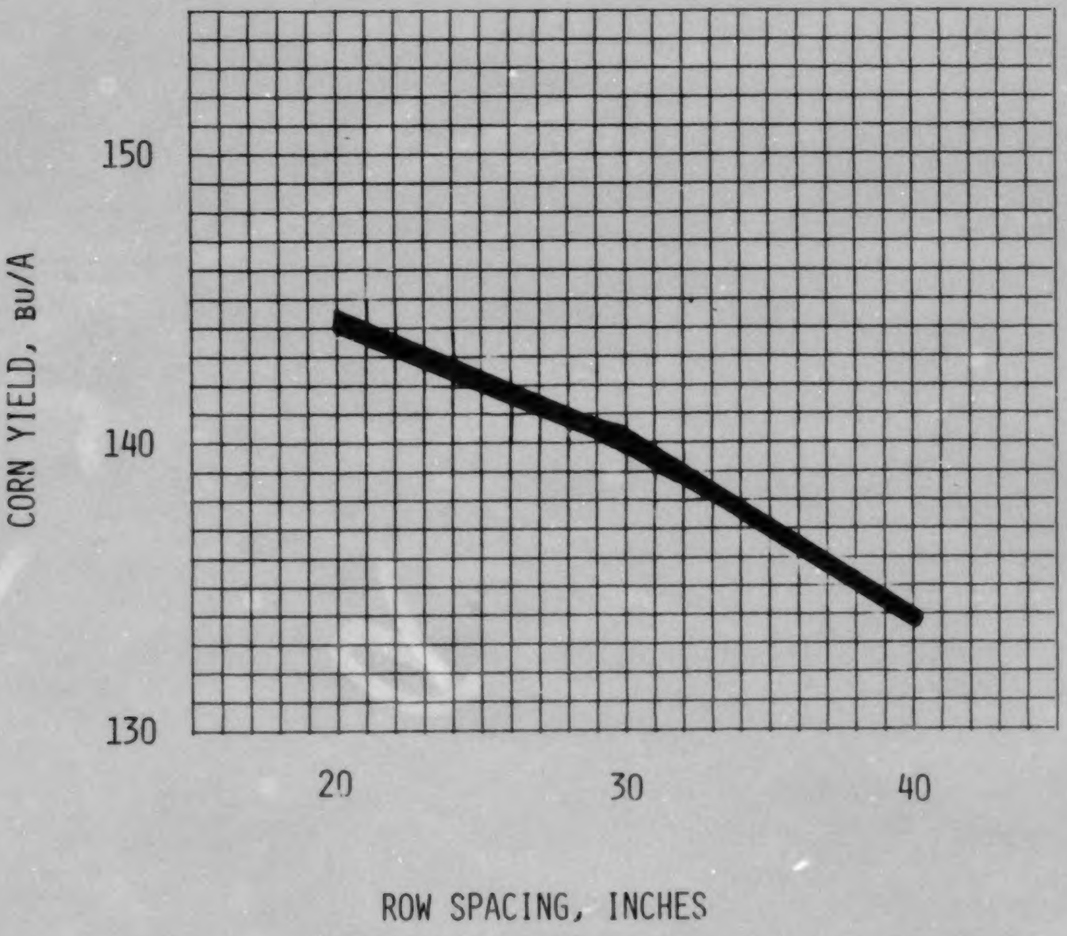


T-7: VARYING SEED DROP AND PLANT POPULATION.

SEED	PLANTS/A		BU/A AT 15 1/2%		
DROP	1972	1973	1972	1973	AVG.
13,500	13,000	12,000	121	111	116
18,000	15,600	15,375	128	121	125
20,900	18,000	19,125	136	143	139
24,400	21,666	20,875	149	144	147
27,800	23,666	23,000	159	151	155
34,900	28,333	28,500	161	152	157

SOURCE: 1974-75 AGRONOMY GUIDE

T-8: CORN ROW WIDTH AND RESULTING YIELD.
(OHIO, 1957-67)



T-8

APPROVED PRACTICES

1. PLANT EARLY, AS NEAR RECOMMENDED DATE AS POSSIBLE.
2. TAKE SOIL TEMPERATURE READINGS.
3. DEVELOP A "CALENDARIZED" PLAN.
4. PLANT NO DEEPER THAN ONE TO ONE AND ONE-HALF INCHES.
5. PLAN FOR HIGH CORN POPULATIONS, PLANTING TEN PERCENT MORE SEEDS THAN THE DESIRED HARVEST STAND.
6. PLANT CORN IN NARROW ROWS WHEN EQUIPMENT CHANGE IS FEASIBLE.
7. SELECT HYBRIDS WITH PROVEN PERFORMANCE RECORDS.
8. DRILL SEEDS RATHER THAN HILL DROPPING THEM.

Adult Unit No. 2

PRODUCING HIGH SOYBEAN YIELDS

A Resource Unit For Adult Education
Classes in Agriculture

Developed by
Clair Jones

Edited by
J. David McCracken

Department of Agricultural Education
College of Agriculture and Home Economics
The Ohio State University
Columbus, Ohio 43210

1975

PREFACE

THIS RESOURCE UNIT WAS DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U. S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN
ASSISTANT PROFESSOR

L. H. NEWCOMB
ASSISTANT PROFESSOR

TABLE OF CONTENTS

	Page
Preface	III
Introduction	1
State Situation	3
Local Situation	3
Objectives	3
References	3
Needed AV Equipment	4
Interest Approach	4
Questions to be Answered	4
Learning Activities	5
To Summarize (Note to Teacher)	7
Application	7
Appendix A: Content Summary	8
Appendix B: Instructional Materials	18

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATIBLE TO THE LOCAL COMMUNITY.

PRODUCING HIGH SOYBEAN YIELDS

State Situation

Average soybean yields have fluctuated between 27 and 30 bushels per acre during the past 10 years in Ohio. Better farmers have been averaging 35-40 bushels per acre. Ohio harvested 3,590,000 acres of soybeans in 1973. Ohio has generally ranked seventh among states in acreage devoted to soybean production.

Local Situation

A. Check with the local county agricultural extension office for your soybean acreage and average yield.

B. Conduct farm visitations to your class members to learn more of your local situation.

C. Determine names of county yield winners and examine their production practices.

Objectives

The major objective is to produce high yielding soybeans. Specific objectives are to:

1. Determine the best planting dates.
2. Plan for conversion to narrow row widths.
3. Determine the optimum seeding rate.
4. Utilize a proper depth of seed placement.
5. Select an adapted variety.

References

1974-75 Agronomy Guide. Cooperative Extension Service, The Ohio State University, Columbus, Ohio: pp. 55-60.

Agronomy Research. Ohio Agricultural Research and Development Center, Wooster, Ohio: Agronomy Department Series 214, July, 1972, pp. 9-13.

Hanway, John J. and Thompson, Harvey E. "How a Soybean Plant Develops." Special Report 53 (Revised). Iowa State University, Cooperative Extension Service, Ames, Iowa: June, 1971.

PENDLETON, J. W. ROW SPACING, SEEDBED PREPARATION AND PLANTING. NEW COMPREHENSIVE MANUAL. MODERN SOYBEAN PRODUCTION, AMBLER, PENNSYLVANIA: AMCHEM PRODUCTS, INC., PP. 22-25.

RYDER, G. J. "EARLIER PLANTING CAN BOOST SOYBEAN YIELDS." OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER, WOOSTER, OHIO: REPRINTED FOR OHIO REPORT: 58(6) 115-116, NOVEMBER, DECEMBER, 1973.

SCOTT, WALTER O. AND ALDRICH, SAMUEL R. MODERN SOYBEAN PRODUCTION. CINCINNATI, OHIO: THE FARM QUARTERLY, 1970.

NEEDED AV EQUIPMENT

CHALKBOARD, OVERHEAD PROJECTOR AND SCREEN, SPROUTED SOYBEAN SEEDLING, AND DRIED SOYBEAN MATURE PLANTS.

INTEREST APPROACH

FIVE OR MORE SOYBEAN FIELDS SURVEY DATA TO BE DEVELOPED IN A BLACKBOARD CHART (SURVEY DATA MUST HAVE BEEN GATHERED IN ADVANCE).

BLACKBOARD CHART

FIELD	ROW WIDTH	PLANTING DATE	VARIETY	FERTILITY LEVEL	WEED CONTROL	YIELD PER ACRE
				(HIGH, MED., LOW)	(GOOD, FAIR, POOR)	

COMMENT: AS YOU SEE WE HAVE SOME DIFFERENCES. TONIGHT, LET US DISCUSS THESE DIFFERENCES AS THEY RELATE TO PLANTING PRACTICES.

QUESTIONS TO BE ANSWERED

1. WHAT ARE THE BEST PLANTING DATES FOR SOYBEANS IN THIS COMMUNITY?

   A. WHAT IS MEANT BY EARLY PLANTING?

   B. WHAT YIELD INCREASE CAN BE EXPECTED?

   C. WHY DO SOYBEAN YIELDS INCREASE WITH EARLY MAY PLANTINGS?

   D. WHY HAVE FARMERS BEEN PLANTING SOYBEANS IN LATE MAY?

   E. HOW DOES TEMPERATURE AFFECT SOYBEAN GERMINATION AND EARLY DEVELOPMENT?

2. Why are narrow rows nearly universally recommended for soybeans?

   A. What is meant by narrow rows?

   B. Why yield increases can be expected?

   C. Why do soybeans give a larger percentage increase than corn with narrow rows?

   D. Why have farmers been growing soybeans in wide rows for the past 30 years?

   E. What number of acres would pay the cost of conversion from the increase yields?

3. What are desirable seeding rates for soybeans?

   A. What seed spacing should we have within the rows?

   B. Do yields increase when plants are seeded at more than one bushel per acre?

   C. What are desirable seeding rates for soybeans?

4. Does depth of planting influence yield?

5. What varieties are adapted for this community?

Learning Activities

1. What are the best planting dates for soybeans in this community?

Point out that the threshold temperature for germination is about 50°F and that soil temperature in the sixties improves rate of emergence and the ability of the plant to compete with weeds. Use transparency #1 to illustrate this concept.

Use transparency #2 to illustrate relative tolerance of soybeans as compared to corn.

Indicate that full-season varieties respond more favorably to early planting than earlier maturing varieties.

Use transparency #3 to summarize the discussion of date of planting. Also use transparency #4 to illustrate the expected yield reduction from delayed planting. Refer to the content summary to develop a list of points for use in summarizing this part of the discussion.

2. Why are narrow rows nearly universally recommended for soybeans?

Refer to pages 55-57 in Scott & Aldrich for a discussion of row width of soybeans. Emphasize that a corn-soybean farmer may be able to

FINANCE THE SWITCH FROM 40 TO 30 INCH ROWS WITH THE INCREASE IN SOYBEANS YIELD ALONE.

USE TRANSPARENCY #5 TO ILLUSTRATE THE YIELD ADVANTAGE OF NARROW ROWS WHICH COMES FROM BETTER LIGHT AND MOISTURE UTILIZATION.

3. WHAT ARE DESIRABLE SEEDING RATES FOR SOYBEANS?

USE TRANSPARENCY #6 TO ILLUSTRATE THE RELATIONSHIP BETWEEN PLANTING RATE AND ROW WIDTH.

USE TRANSPARENCY #7 TO ILLUSTRATE THE RELATIONSHIP OF VARIETY TO BE PLANTED AND PLANTING RATE.

USE TRANSPARENCIES #8-9 TO ILLUSTRATE THE RELATIONSHIP BETWEEN SEED SIZE AND POUNDS OF BEANS PLANTED PER ACRE.

INDICATE THAT OVERPLANTING IS MORE COMMON THAN UNDERPLANTING.

USE TRANSPARENCIES #10-12 TO REPORT RESEARCH ON PLANT POPULATION AND YIELD.

USE TRANSPARENCIES #13-14 AND HANDOUT #1 TO ILLUSTRATE HOW TO PLANT FOR A PROPER RATE. USE SEVERAL EXAMPLES.

4. DOES DEPTH OF PLANTING INFLUENCE YIELD?

REFER TO PAGE 55 IN SCOTT & ALDRICH FOR CONTENT. NOTE 1 TO 1 1/2" IS ABOUT THE MAXIMUM DEPTH FOR EMERGENCE FOR MANY TYPES OF SOILS. ALSO NOTE THAT INSECT DAMAGE AND WEEDS ARE LESS A PROBLEM WITH FAST EMERGENCE.

USE TRANSPARENCIES #15-16 TO ILLUSTRATE HYPOCOTYL DAMAGE AND DIFFERENCE AMONG VARIETIES.

5. WHAT VARIETIES ARE ADAPTED FOR THIS COMMUNITY?

OBTAIN LATEST YIELD DATA FOR ADAPTED VARIETIES FROM THE COUNTY EXTENSION OFFICE.

DISCUSS FACTORS IN SELECTING A VARIETY.

(1) MATURITY

(2) LODGING RESISTANCE

(3) SHATTER RESISTANCE

(4) DISEASE RESISTANCE

(5) YIELD

DISCUSS LOCAL YIELD DATA AND COMPARE WITH RESEARCH RESULTS OBTAINED FROM COUNTY EXTENSION OFFICE.

To Summarize (Note to Teacher)

Develop with the class some improved practices to use and write these practices on the blackboard.

1. Prepare a good seedbed.
2. Plant soybeans in 30 inch rows.
3. Plant soybeans in early May.
4. Plant soybeans at a depth of 1 inch.
5. Carefully check out and adjust soybean planting equipment.

Application

A. Farm visits to class members.

B. Field trip to OARDC and Farm Science Review.

C. Develop farm demonstration plots.

D. Hand plant some soybeans. Plant in April and observe. (Note - Be aware of unsafe herbicides to soybeans.)

E. Compare practices and note for future references.

APPENDIX A

CONTENT SUMMARY

1. TEMPERATURE AND PLANTING DATE
2. OTHER FACTORS THAT INFLUENCE DATE OF PLANTING
3. EARLY PLANTING WILL INCREASE SOYBEAN YIELDS
4. PLANTING DATE
5. ROW WIDTH STUDY ON SOYBEANS
6. ROW WIDTH - PLANTING RATE STUDY ON SOYBEANS
7. DATE OF PLANTING SOYBEANS
8. DRILL VS ROW PLANTING

TEMPERATURE AND PLANTING DATE[1]

THE THRESHOLD TEMPERATURE FOR GERMINATION IS AROUND 50 DEGREES. UNLESS THE TEMPERATURE IS INCREASING STEADILY, PLANTING WHEN THE SOIL IS IN THE LOW 50'S MAY NOT BE ADVISABLE. EMERGENCE OCCURS VERY SLOWLY WHEN THE SOIL IS COLD. ADDITIONALLY, THE SEEDLING IS SUBJECT TO ATTACK BY SOIL ORGANISMS AND IT IS A POOR WEED COMPETITOR UNDER COLD SOIL CONDITIONS. A SEEDLING WILL EMERGE FIVE TO SEVEN DAYS AFTER PLANTING WHEN THE SOIL TEMPERATURE REACHES THE MIDDLE AND UPPER 60'S.

THE SOIL IS OFTEN HOT AND DRY WHEN SOYBEANS ARE PLANTED FOLLOWING A SMALL GRAIN CROP IN A DOUBLE-CROPPING SYSTEM. IDEALLY, SOYBEANS SHOULD NOT BE PLANTED WHEN THE SOIL TEMPERATURE IS HIGH UNLESS SUFFICIENT MOISTURE FOR RAPID GERMINATION IS PRESENT OR ASSURED. SOYBEAN SEED LOSES VIGOR WHEN SUBJECTED TO HIGH TEMPERATURE. THIS IS PARTICULARLY TRUE IF THE HUMIDITY IS ALSO HIGH. THE COMBINATION OF HIGH TEMPERATURE AND HIGH HUMIDITY MAY BE ENCOUNTERED UNDER FIELD CONDITIONS, AS WELL AS IN A STORAGE BIN. THERE MAY BE JUST ENOUGH MOISTURE IN THE SOIL TO START GERMINATION, BUT NOT ENOUGH TO FINISH IT. THE VIGOR AND VITALITY OF THE SEED WILL DECREASE RAPIDLY UNDER HIGH TEMPERATURE CONDITIONS, AND STANDS MAY BE POOR.

OTHER FACTORS THAT INFLUENCE DATE OF PLANTING[2]

THROUGHOUT MOST OF THE NORTHERN SOYBEAN PRODUCTION REGION, CORN COMPETES WITH SOYBEANS FOR TIME AND EQUIPMENT. WHERE BOTH CROPS ARE GROWN ON THE SAME FARM, IT MAY BE MORE PROFITABLE TO PLANT CORN BEFORE SOYBEANS. CORN SUFFERS A PROPORTIONALLY LARGER YIELD DECLINE AS A RESULT OF PLANTING DELAYS THAN DO SOYBEANS. THE THREE-YEAR YIELD OF CLARK, A FULL-SEASON VARIETY, AT URBANA, ILLINOIS, DECLINED AN AVERAGE OF 3.6 PERCENT AS PLANTING DATE WAS DELAYED FROM EARLY MAY TO THE LAST OF MAY OR THE FIRST OF JUNE. CONSERVATIVELY, IT CAN BE ESTIMATED THAT THE SAME DELAY IN PLANTING CORN WOULD CAUSE A LOSS OF 10 TO 20 PERCENT IN YIELD.

THE STUDY OF THE CLARK VARIETY ALSO INCLUDED SHELBY, HAROSOY, AND CHIPPEWA. SHELBY MATURES 7 TO 10 DAYS EARLIER THAN CLARK; HAROSOY, ABOUT THREE WEEKS EARLIER; AND CHIPPEWA, A MONTH EARLIER THAN CLARK. SHELBY, LIKE CLARK, PRODUCED BEST WHEN PLANTED IN EARLY MAY. THE YIELDS OF BOTH HAROSOY AND CHIPPEWA WERE HIGHEST WHEN PLANTED IN LATE MAY. THE YIELDS OF ALL FOUR VARIETIES DECLINED RAPIDLY WHEN PLANTING WAS DELAYED PAST EARLY JUNE. THE RESULTS OF THIS AND SIMILAR EXPERIMENTS LEAD TO THESE CONCLUSIONS:

---

[1] SCOTT, WALTER O. AND ALDRICH, SAMUEL R. MODERN SOYBEAN PRODUCTION. CINCINNATI, OHIO: THE FARM QUARTERLY, 1970. PP. 50-51.

[2] IBID.

.. Varieties that require most of the growing season to mature will produce their highest yield when planted as soon as the soil temperature or day length will allow. The yield of these varieties usually declines as planting is delayed. However, the loss in yield is relatively minor for the first two or three weeks of delay; after that, the loss is likely to be much more severe.

.. Early varieties often do not respond to early planting. They usually produce higher yields when planting is delayed for two to three weeks. Selecting the best planting date may be more critical in the case of early varieties. Their yields tend to peak during a relatively short period. For instance, the yield of Harosoy at Urbana when planted in late May was 2.5 bushels per acre higher than when planted earlier, and about 7 bushels per acre more than late June plantings.

Early Planting Will Increase Soybean Yields

by

Gordon J. Ryder[3]

Average soybean yields have fluctuated between 27 and 30 bushels per acre during the past 10 years in Ohio. Better farmers have been averaging 35-40 bushels per acre. By using more of the presently known good management practices, top farmers could increase their average yield another 10 bushels per acre. State average yields in Ohio could easily move above 40 bushels per acre if priority were given to the production of soybeans. Early May planting can increase soybean yields as much as any other change in production practices.

The U.S.D.A. Statistical Reporting Service shows that for the last three years, only 20 percent of Ohio's soybean crop is planted by May 20 and only 45 percent by June 1. An additional 30 percent is planted by June 10.

Planting date studies with soybeans have recently been completed in Ohio showing that yields decrease nearly 3 bushels per acre for each 10-day delay in planting after the first of May. The planting date research was conducted at the Northwestern and Western Branches of the Ohio Agricultural Research and Development Center in 1970, '71, and '72. Four varieties were planted each year -- Harosoy 63, Beeson, Wayne and Calland. All varieties were planted in thirty inch rows, one inch deep, at a seed drop of six beans per foot. With two exceptions, all plantings were made within two days of May 1, 10, 20, and 30 each year.

---

[3] Professor, The Ohio State University, Columbus and Ohio Agricultural Research and Development Center, Wooster, Ohio.

THE NORTHWEST BRANCH IS ABOUT 100 MILES NORTH OF THE WESTERN BRANCH OF OARDC. TO SHOW THE DATE OF PLANTING RESPONSE TO YIELD, TABLE I AND TABLE II SHOW THE DATA FOR THE THREE YEAR PERIOD AT EACH LOCATION.

TABLE I SOYBEAN PLANTING DATE YIELDS

WESTERN BRANCH, OARDC

	YIELDS BUSHEL PER ACRE				DIFFERENCE
VARIETY	MAY 1	MAY 10	MAY 20	MAY 30	MAY 1 OVER MAY 30
	BU/A	BU/A	BU/A	BU/A	BU/A
HAROSOY 63	48.2	45.1	42.1	35.8	12.4
BEESON	51.6	48.9	41.2	40.6	11.0
WAYNE	54.0	49.7	47.3	43.5	10.5
CALLAND	53.3	49.7	46.4	48.5	4.8
AVE.	51.8	48.4	44.3	42.1	9.7

LSD (5%) .7

TABLE II SOYBEAN PLANTING DATE YIELDS

NORTHWESTERN BRANCH, OARDC

	YIELDS BUSHEL PER ACRE				DIFFERENCE
VARIETY	MAY 1	MAY 10	MAY 20	MAY 30	MAY 1 OVER MAY 30
	BU/A	BU/A	BU/A	BU/A	BU/A
HAROSOY 63	46.1	45.1	42.8	37.5	8.6
BEESON	51.7	45.8	45.1	40.6	11.1
WAYNE	51.6	47.5	46.0	42.9	8.7
CALLAND	48.7	46.2	45.2	41.3	7.4
AVE.	49.6	46.1	44.8	40.6	9.0

LSD (5%) .7

WHEN COMPARING THE DIFFERENCE IN YIELD OF THE MAY 1 OVER THE MAY 30 DATE OF PLANTING FOR ALL VARIETIES THERE IS ESSENTIALLY NO DIFFERENCE BETWEEN NORTHERN OHIO AT HOYTVILLE AND SOUTHWESTERN OHIO AT SOUTH CHARLESTON. THERE ARE SOME DIFFERENCES FOR INDIVIDUAL VARIETIES TESTED BETWEEN THE TWO LOCATIONS. THESE DATA SHOW A YIELD ADVANTAGE FOR EARLY PLANTING IN BOTH NORTHERN AND SOUTHERN OHIO.

THE YIELDS SHOWN IN TABLE III ARE A COMPILATION OF THREE YEARS DATA FROM THE TWO LOCATIONS.

TABLE III SOYBEAN PLANTING DATE YIELDS

1970-72

WESTERN AND NORTHWESTERN BRANCHES, OARDC

VARIETY	YIELDS BUSHEL PER ACRE MAY 1	 MAY 10	 MAY 20	 MAY 30	DIFFERENCE MAY 1 OVER MAY 30
	BU/A	BU/A	BU/A	BU/A	BU/A
HAROSOY 63	47.2	45.1	42.5	36.7	10.5
BEESON	51.7	47.3	43.1	40.6	11.1
WAYNE	52.8	48.6	46.6	43.2	9.6
CALLAND	51.0	47.9	45.7	44.9	6.1
AVE.	50.7	47.2	44.5	41.3	9.4

LSD (5%) .9 BU.
CV 5.9%

AVERAGE YIELD FIGURES FOR THE FOUR VARIETIES SHOW A 9.4 BUSHEL HIGHER YIELD FOR MAY 1 PLANTING THAN FOR THE MAY 30 PLANTING DATE. THE DATA SHOW A STRAIGHT-LINE DECLINE IN YIELD AS THE PLANTING IS DELAYED. SINCE THE HIGHEST AVERAGE YIELD WAS ON THE EARLIEST PLANTING DATE IT WOULD INDICATE THAT EARLIER PLANTINGS MAY PRODUCE HIGHER YIELDS.

A POSSIBLE 10-BUSHEL YIELD INCREASE WITH NO ADDITIONAL COSTS SHOULD NOT BE OVERLOOKED. WHERE CAN YOU INCREASE YOUR NET PROFIT ANY EASIER?

SEVERAL REASONS, OR EXCUSES, ARE GIVEN FOR THE LATE PLANTINGS OF SOYBEANS. FOREMOST IS GETTING THE CORN PLANTED FIRST, WHICH IS A VALID REASON BECAUSE CORN YIELDS DECREASE MORE WHEN PLANTED AFTER MAY 15 THAN DO SOYBEANS. BUT CORN SHOULD BE PLANTED MUCH EARLIER THAN IT IS FOR MAXIMUM YIELD. NEARLY EVERY YEAR SOIL MOISTURE CONDITIONS ARE SATISFACTORY TO PLANT DURING THE LAST TWO WEEKS OF APRIL. MOST GROWERS HAVE BEEN MISSING THIS OPPORTUNITY TO GET CORN PLANTED. BY STARTING TO PLANT CORN AFTER MAY 1 THEY ARE LOSING POTENTIAL CORN AND SOYBEAN YIELDS BECAUSE BOTH CROPS ARE BEING PLANTED TOO LATE. OTHER REASONS FOR DELAY ARE: POOR DRAINAGE WHICH CAUSES DELAY IN PLANTING, FEAR OF FROST DAMAGE, FEAR OF POOR WEED CONTROL, AND THE DANGER OF POOR STANDS ON EARLY PLANTING.

IT IS A COMMON BELIEF THAT IF THE SOYBEAN CROP IS PLANTED LATE, AN EARLIER VARIETY SHOULD BE USED TO COMPENSATE FOR LATE PLANTING BY ASSURING MATURITY BEFORE FROST. THIS HOLDS TRUE FOR SOME CROPS, BUT NOT FOR SOYBEANS. THE DATA IN TABLE I SHOW A 10.5 AND 11.1 BUSHEL DECREASE IN yield for the two earlier varieties, Harosoy 63 and Beeson. The later maturing varieties, Wayne and Calland, show a yield decline of 9.6 and 6.1 bushels, respectively.

This difference is related to plant height and size. The height of the early varieties decreases more than that of the later maturing varieties when planting is delayed beyond mid-May. To produce high soybean yields it is necessary to separate the vegetative growth stage from the reproductive stage by planting early enough to obtain near maximum plant height before the pod fill stage begins. In this experiment the Harosoy 63 variety showed first blossoms on June 24-26 and Calland on July 10-12 each of the three years. This additional two weeks for vegetative growth before blossoming contributed toward higher yields for late varieties planted late. For late May or June planting, select the latest variety that has a reasonable chance of maturing by the time of the first killing frost. When the vegetative period is shortened, the effect on soybeans is usually a reduction in both yield and height of plant. Narrow rows help compensate for small plants.

Producers are overly concerned about frost damage on early May plantings. The cold tolerance of a young soybean plant is high. A frost that will kill corn to ground level will probably only kill the uppermost growing tip on soybean plants. The apical meristem is at the apex of the shoot, and if damaged or killed by frost, there are dormant buds present where the cotyledons, unifoliolate and trifoliolate leaves join the main stem which are capable of producing one or more new stems. Frost damage to young plants will be much less in undisturbed soil with a light crust than in freshly cultivated soil. Heat released from bare non-cultivated soil causes the air temperature near the soil to be higher than air temperature at the one to three-foot height. Weather records show that there is less than five percent chance of a freeze after May 1 severe enough to kill the plant except in four or five Northeast Ohio counties.

Depth of seed placement is critical on early May plantings. Most farmers using corn planters plant 1 1/2 to 3-inches deep. Correct depth is one inch. Deeper planting causes delayed emergence because of the decrease in soil temperature with depth.

In soils that crust badly, deep plant places the seed below the crust, preventing emergence, or causing the need for rotary hoeing prior to or during emergence. Either way, stand is reduced. By planting at the one inch depth, seed will be in the crusting area. As the seed swells during germination the crust is fractured near the seed, permitting better emergence. Preliminary studies show a five to eight percent seed mortality when planted one inch deep and a 35 to 40 percent mortality when planted two inches deep, both with a firm crust. Planting at the one inch depth requires the proper herbicide combinations to prevent seedling damage. Shallow planting reduces the time to emerge and reduces the probability of crust inhibition.

For top soybean yields, plant between May 1 and May 10, using the latest maturing variety that will mature before frost. Plant one inch deep, select highly fertile soil, use good weed control, and harvest on time.

It would be impossible for everyone to plant all his soybeans on May 1. But if those who have been planting during the last half of May would plant between May 1 and May 10 and those planting in June would advance their planting to May 20-30, yields would increase. Making these changes would probably increase the net income to Ohio soybean farmers by $75,000,000, using the 1972 acreage and a price of $3.75 per bushel.

Farmers in the above example changing to early May planting would gain three to six bushels or $11 to $23 per acre. Those changing from June to late May planting would increase their yields six to 17 bushels or $23 to $64.

Planting Date

The data from the chart shown at transparency #4 is a compilation of planting date yields from two experiments at the Western and Northwestern Branches, OARDC.

The May plantings are from the date of planting study reported in another mimeograph. The June 10 date is two year data which is of the two locations with Beeson and Wayne. The June 20 and 30 dates are from the double cropping work for a two year period at both research farms. The soil types were Crosby silt loam at Western and Hoytville silty clay at Hoytville.

This yield decrease is a nearly straight line effect as the data of planting is delayed.

Crop Reporting Service data shows that only 45% of the soybeans emerged are planted by May 30 in Ohio from 1969 to 1972. The 1973 date of planting was considerably later. It is easy to calculate the production increased in bushels potential that could be gained by moving the date of planting earlier at any one of the increments shown.

Row Width Study on Soybeans

Gordon J. Ryder

Columbus

Row width studies conducted about fifteen years ago indicated that drilled soybeans outyielded any wider row width if weed competition could be controlled. Planting in 20 to 40 inch rows has become a common prac-

TICE SO THAT CULTIVATION CAN BE ACCOMPLISHED. WITH MORE SPECIFIC HERBICIDES NOW AVAILABLE THIS PRACTICE NEEDED TO BE RE-EVALUATED.

THIS STUDY WAS INITIATED IN 1972 USING THREE VARIETIES. AMOSY 71, BEESON, AND CALLAND. ROW WIDTHS OF 7 AND 14 INCHES WERE PLANTED WITH A GRAIN DRILL, AND 20, 30, AND 40-INCH ROW WIDTHS WERE PLANTED WITH A BEET AND BEAN PLANTER. THE STUDY WAS LOCATED ON HIGH FERTILITY BROOKSTON SILT LOAM. HERBICIDE APPLICATION WAS AMIBEN + LASSO AT RECOMMENDED RATES.

ROW WIDTH - PLANTING RATE STUDY ON SOYBEANS

GORDON J. RYDER

WESTERN AND NORTHWESTERN BRANCHES

THE PLANTING RATE RECOMMENDATIONS FOR SOYBEANS HAVE BEEN IMPOSSIBLE FOR A FARMER TO FOLLOW WITH ANY PRECISION. SEED SIZE VARIES BETWEEN VARIETIES AND YEARS. SEED PLATES HAVE SUCH LARGE CELLS THAT ACCURACY IS QUESTIONABLE. GEAR RATIOS ON PLANTERS ARE NOT EASILY CHANGED TO DROP 100,000 TO 200,000 SEEDS PER ACRE. THIS STUDY WAS INITIATED TO REFINE THE PRECISION IN PLANTING RATES SO THAT GOOD RECOMMENDATIONS CAN BE MADE TO FARMERS.

THIS PROGRESS REPORT IS FOR TWO YEARS AT TWO LOCATIONS. TWO VARIETIES, BEESON AND CALLAND, WERE PLANTED. THE SEED WAS SIZED TO A SEED LOT THROUGH A 19/64-INCH AND ON A 17/64-INCH ROUND HOLE SCREEN. PLANTING WAS WITH A LUSTRAN PLASTIC SEED PLATE COX-24 WHICH CARRIES TWO SEEDS PER CELL. THE SEED WEIGHT WAS 2300 BEANS PER POUND. THE PLANTING RATE WAS 110,000, 155,000 AND 200,000 BEANS PER ACRE IN 20-INCH AND 30-INCH ROWS.

EFFECT OF SOYBEAN RATE AND ROW SPACING ON SOYBEAN YIELDS.
2-YR. AVERAGE

PLANTING RATE (SEEDS/A)	BEESON ROW WIDTH (IN.) 20	30	CALLAND ROW WIDTH (IN.) 20	30
110,000	46.0	45.4	52.2	50.2
155,000	50.3	46.8	54.2	49.9
200,000	55.2	46.6	55.5	49.2

PRELIMINARY DATA SHOW THAT YIELDS WERE SLIGHTLY HIGHER WITH 20 INCH THAN WITH 30 INCH ROWS FOR BOTH VARIETIES. CALLAND NORMALLY BRANCHES MORE WHEN PLANTED IN WIDE ROWS OR AT LOW SEEDING RATES THAN BEESON. THESE DATA SEEM TO INDICATE THAT THE CALLAND VARIETY YIELDS ARE HIGHER AT THE LOW SEEDING RATE AND IN WIDER ROWS THAN THE BEESON VARIETY.

DATE OF PLANTING OF SOYBEANS

GORDON J. RYDER

WESTERN AND NORTHWESTERN BRANCHES

TIMELINESS IS ONE OF THE MOST IMPORTANT MANAGEMENT PRACTICES IN CROP PRODUCTION, SOYBEAN PRODUCTION IS NOT EXCLUDED. FOR MAXIMUM YIELD IT IS IMPORTANT TO GET THE MAXIMUM VEGETATIVE GROWTH PRIOR TO THE BEGINNING OF THE REPRODUCTIVE STAGE OF PLANT GROWTH. THE SOYBEAN PLANT COMES INTO BLOSSOM A FEW DAYS AFTER THE CHANGE IN DAY LENGTH ON JUNE 21.

TO RE-EMPHASIZE THIS YIELD EFFECT FOUR VARIETIES AS SHOWN WERE PLANTED AT TEN-DAY INTERVALS AT BOTH BRANCHES IN 1970 AND 1971.

EFFECT OF DATE OF PLANTING ON SOYBEAN YIELDS

	YIELDS (BU. PER ACRE)			
VARIETIES	MAY 1	MAY 10	MAY 20	MAY 30
HAROSOY 63	46.8	44.2	42.1	35.9
BEESON	50.5	46.7	42.2	39.6
WAYNE	53.1	47.7	45.6	42.3
CALLAND	50.4	46.7	44.5	43.8
AVERAGE	50.2	46.4	43.6	40.5

THE AVERAGE OF THE FOUR VARIETIES SHOWED AN INCREASE OF 10 BUSHELS PER ACRE BY PLANTING MAY 1 COMPARED TO MAY 30. EACH VARIETY SHOWED ABOUT THE SAME DEGREE OF YIELD INCREASE. THE DECREASE IN YIELD WAS RATHER CONSTANT FOR EACH PLANTING PERIOD, ABOUT 3 BUSHELS FOR EACH 10 DAYS DELAY IN PLANTING.

RECOMMENDATIONS: PLANTING AS EARLY IN MAY AS POSSIBLE IS PROFITABLE FOR BOTH MID AND FULL SEASON VARIETIES.

DRILL VS ROW

THE EXPERIMENT ON TRANSPARENCY #5 WAS CONDUCTED AT THE NORTHWESTERN BRANCH, OARDC AND COLUMBUS IN 1973. THE 1972 DATA SHOWN ABOVE INDICATES THAT IN ALL CASES THE 40" ROW WIDTH WAS 6-10 BUSHELS PER ACRE LESS THAN OTHER ROW WIDTHS. THE THIN LINED VARIETIES (AMSOY, WHICH HAS NO BRANCHES) GAVE THE HIGHEST YIELD IN THE 7" ROWS. THE OTHER VARIETIES WHICH ARE SLIGHT TO MODERATE BRANCHING TYPES HAD SLIGHTLY HIGHER YIELDS AT THE PLANT POPULATIONS AT THE 20" ROW SPACING. THE DIFFERENCE IN YIELD BETWEEN THE 20 AND 30" ROW WAS ONLY STATISTICALLY SIGNIFICANT WITH THE VARIETY BEESON.

IT WILL BE NOTED THAT THE 14" ROW SPACING FOR ALL VARIETIES PLUS THE 7" ROW WIDTH FOR WILLIAMS WERE LOWER YIELDING THAN THE 7" ROW SPACING. THIS YIELD DIFFERENCE WAS CAUSED BY GRASSY TYPE WEEDS STARTING BEFORE THE SOYBEANS COULD FORM A LEAF CANOPY IN THE 14" ROWS. THERE WERE ABOUT THE SAME AMOUNT OF WEEDS IN THE 7" ROWS BUT BY THE LEAF CANOPY SHADING THE SMALL LEAVES, THEY DID NOT BECOME A PROBLEM TO THE POINT OF REDUCING YIELD.

Appendix B

Instructional Materials

Handouts

H-1: Plant Population at Row Widths Used for Soybeans

Transparencies

T-1: Soil Temperature

T-2: Soybeans are Tolerant to Delayed Planting

T-3: Soybean Planting Date Yields

T-4: Soybean Yields Decrease with Delayed Planting

T-5: Yield of Soybeans at Various Row Spacings

T-6: Planting Rates and Row Width

T-7: Soybean Plant Branching

T-8: Variation in Seed Size

T-9: Soybean Varieties

T-10: Effect of Plant Population on Soybean Yield

T-11: Effect of Row Width and Planting Rate

T-12: Suggested Soybean Seeding Rate

T-13: Planting Date and Germination

T-14: Row Width and Seeding Rate

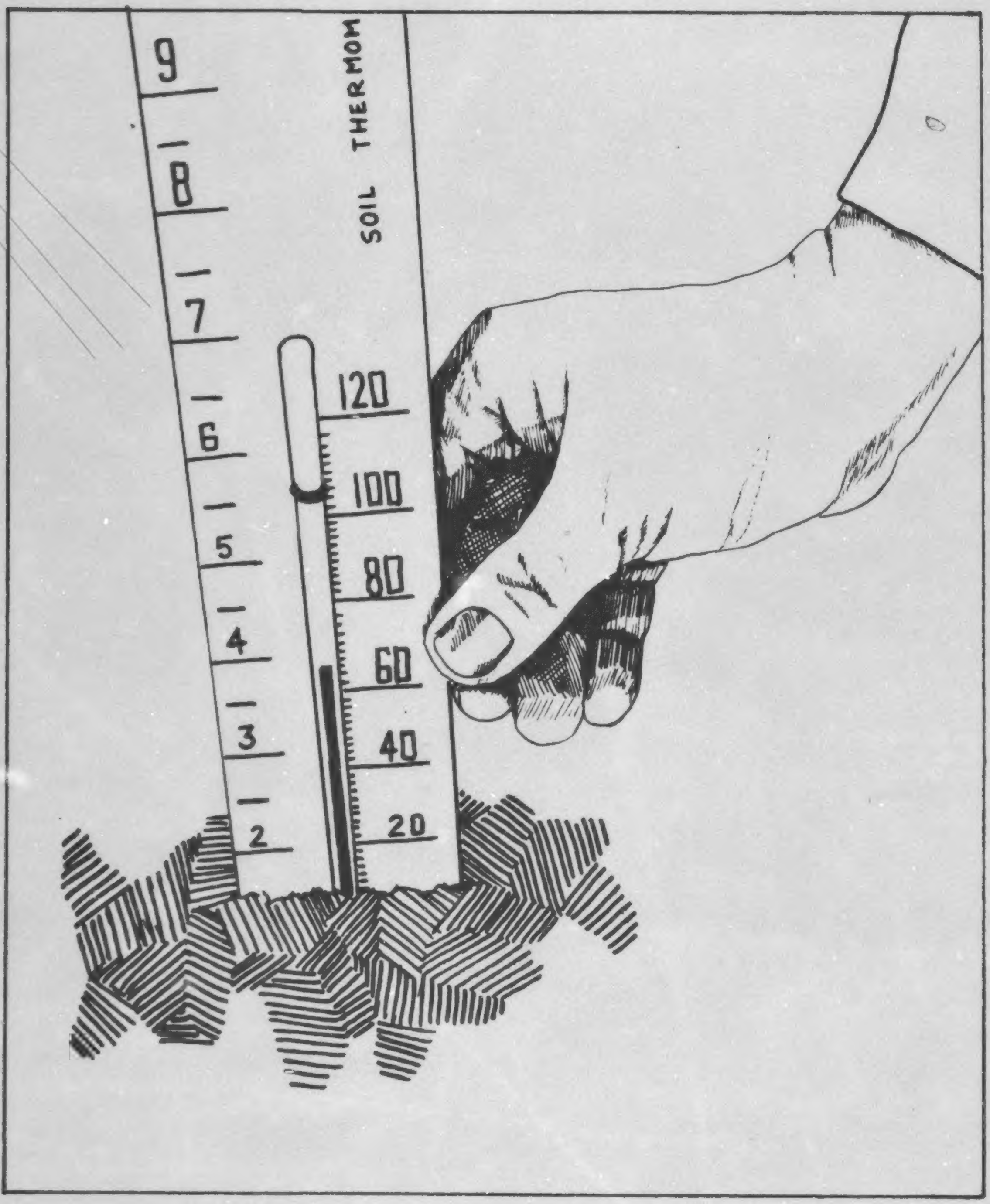
T-15: Effect of Deep Planting

T-15: How Two Varieties Differ in Emergence

PLANT POPULATION AT ROW WIDTHS USED FOR SOYBEANS

Row width (inches)	Linear feet per acre	Plants per foot of row					
		12	9	8	6	4	3
7	74,674	896,088	672,066	597,392	448,044	298,696	224,022
10	52,272	627,264	470,448	418,176	313,632	209,088	156,816
14	37,337	448,044	336,033	298,696	224,022	149,348	112,011
20	26,136	313,632	235,224	209,088	156,816	104,544	78,408
21	24,891	298,692	224,019	199,128	149,346	99,564	74,673
24	21,780	261,360	196,020	174,240	130,680	87,120	65,340
28	18,669	224,028	168,021	149,352	112,014	74,676	56,007
30	17,424	209,088	156,816	139,392	104,544	69,696	52,272
36	14,520	174,240	130,680	116,160	87,120	58,080	43,560
40	13,068	156,816	117,612	104,544	78,408	52,272	39,204

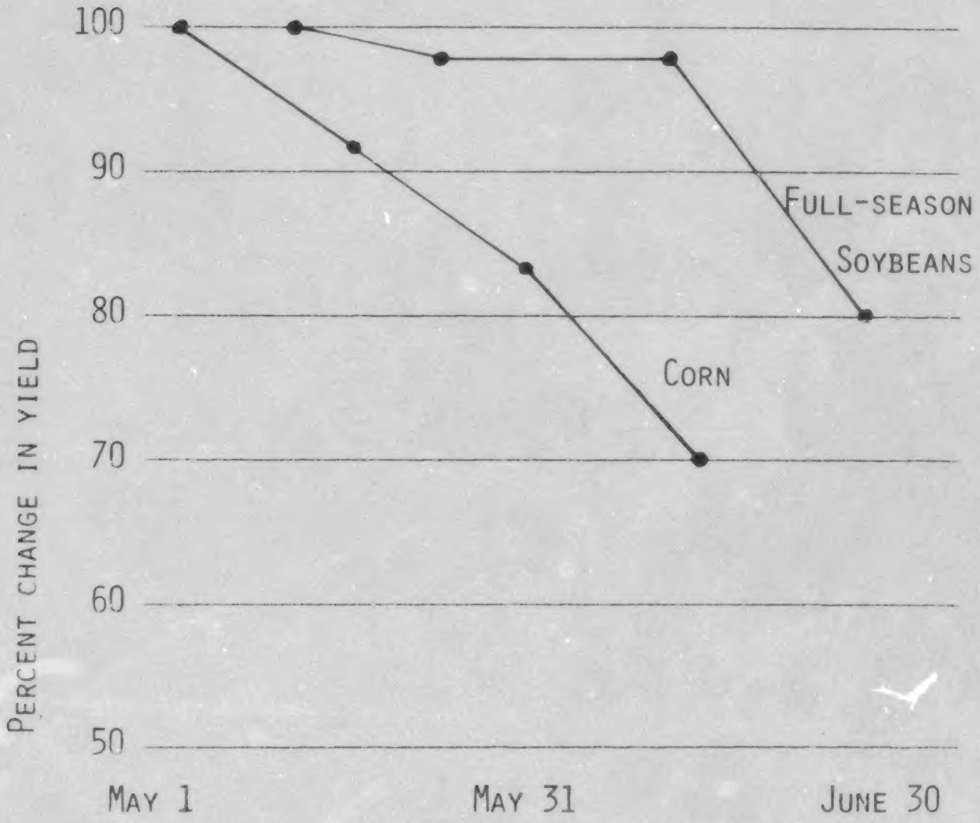
SOIL TEMPERATURE


9
8
7
6
5
4
3
2
SOIL THERMOM
120
100
80
60
40
20

WHEN THE SOIL TEMPERATURE AT SEED PLACEMENT DEPTH IS IN THE MID- TO UPPER 60'S, SOYBEANS CAN BE EXPECTED TO EMERGE FIVE TO SEVEN DAYS AFTER PLANTING.

T-1

SOYBEANS ARE TOLERANT TO DELAYED PLANTING

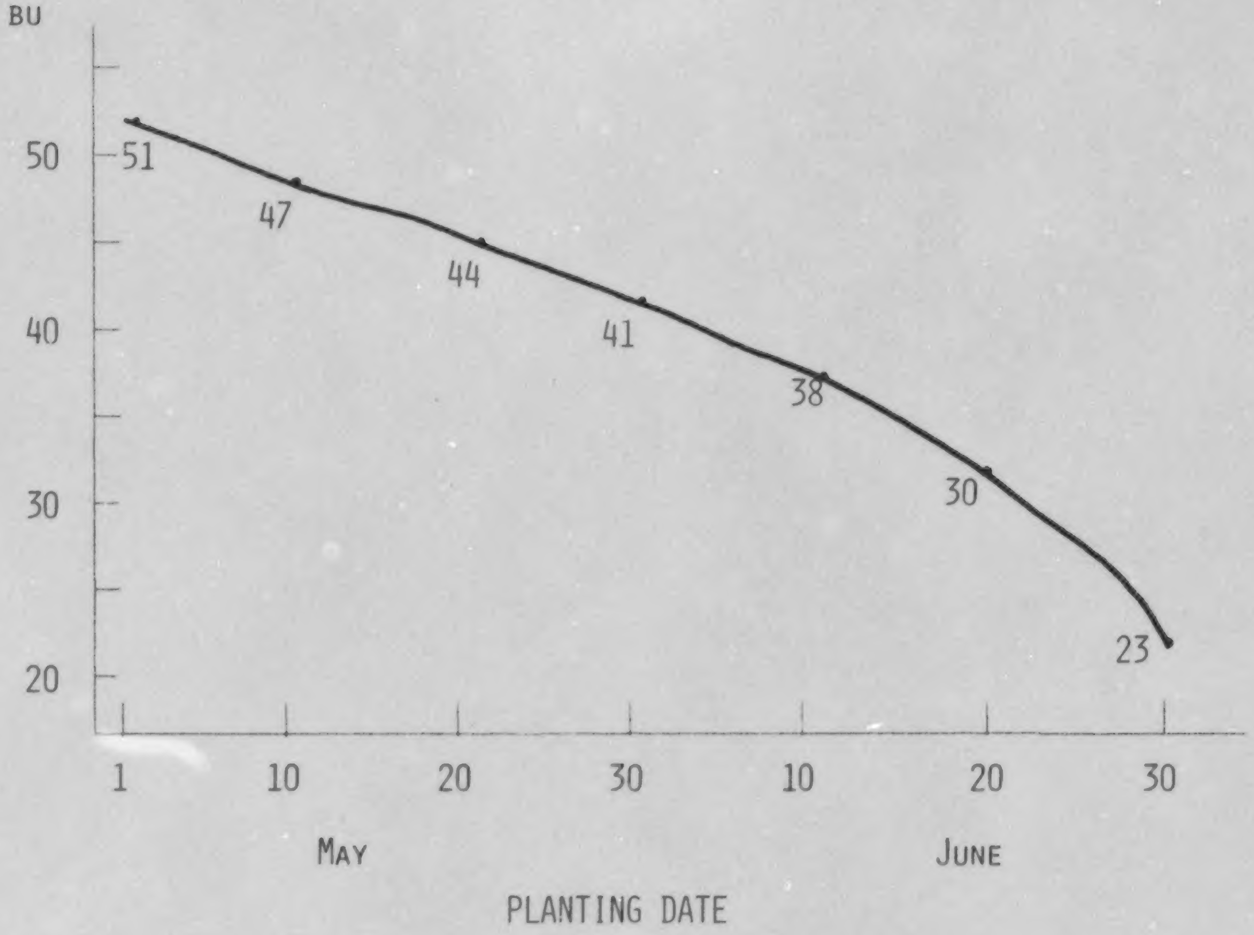


IN MOST CASES, THE YIELD PENALTY FOR DELAYED CORN PLANTING IS SEVERE. ON THE OTHER HAND, THE PENALTY FOR A DELAY IN PLANTING SOYBEANS DOES NOT BECOME SEVERE UNTIL AFTER JUNE 1. THIS IS WHY CORN IS PLANTED BEFORE SOYBEANS.

SOYBEAN PLANTING DATE YIELDS

	Yields (bu/A)				Difference in May 1 and May 30
VARIETY	May 1	May 10	May 20	May 30	Diff.
HAROSOY^{63}	47.2	45.1	42.5	36.7	10.5
BEESON	51.7	47.3	43.1	40.6	11.1
WAYNE	52.8	48.6	46.6	43.2	9.6
CALLAND	51.0	47.9	45.7	44.9	6.1
AVERAGE	50.7	47.2	44.5	41.3	9.4

SOYBEAN YIELDS DECREASE WITH DELAYED PLANTING

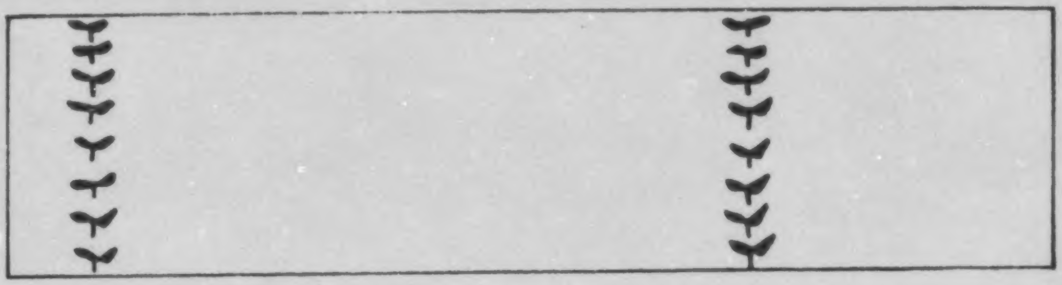


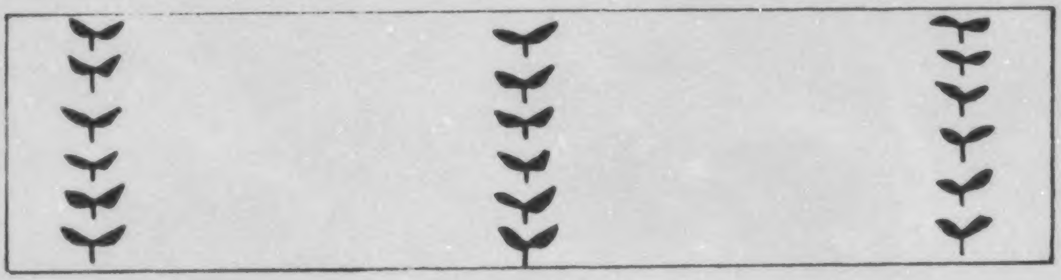
T-4

YIELD OF SOYBEANS AT VARIUOS ROW SPACINGS
(Row Width in Inches)

VARIETY	7'' Bu/A	14'' Bu/A	20'' Bu/A	30'' Bu/A	40'' Bu/A
Amsoy	56.2	46.3	54.1	54.6	46.3
Beeson	53.8	47.4	59.7	52.7	44.4
Calland	52.1	50.5	56.9	55.7	48.6
Williams	48.1	47.8	57.0	55.4	45.6
AVERAGE	52.5	48.0	56.9	54.6	46.2

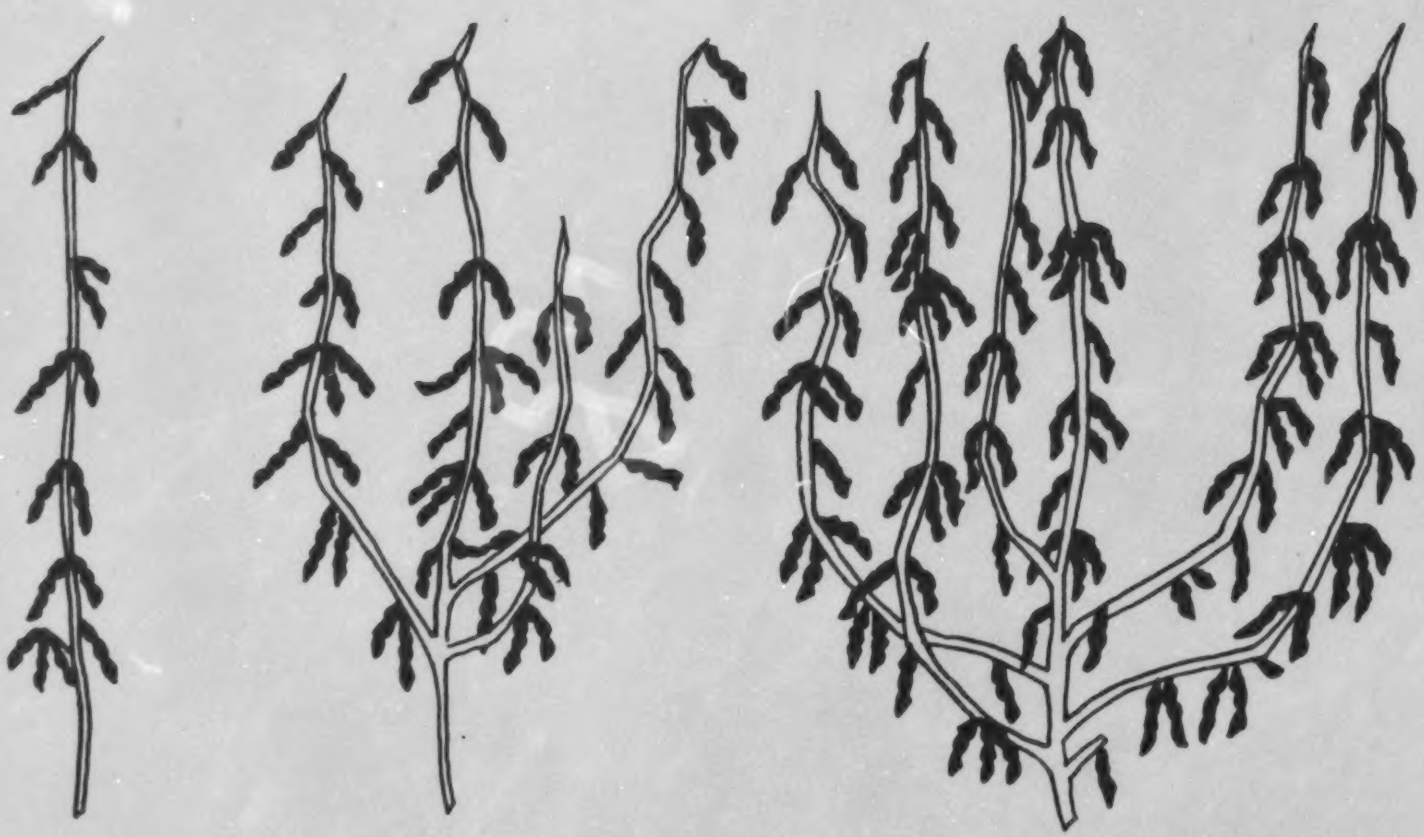
PLANTING RATES AND ROW WIDTH





Planting rates should be reduced as rows are narrowed. A general recommendation is to have 10 plants per foot of row in 40-inch rows (top); 8 plants per foot in 30-inch rows (middle); and 6 plants per foot in 20-inch rows (bottom). The drawing makes it easy to see that if the planting rate for 40-inch rows is used in 20-inch rows, 30 plants will be crowded into the area normally allotted to 20 plants.

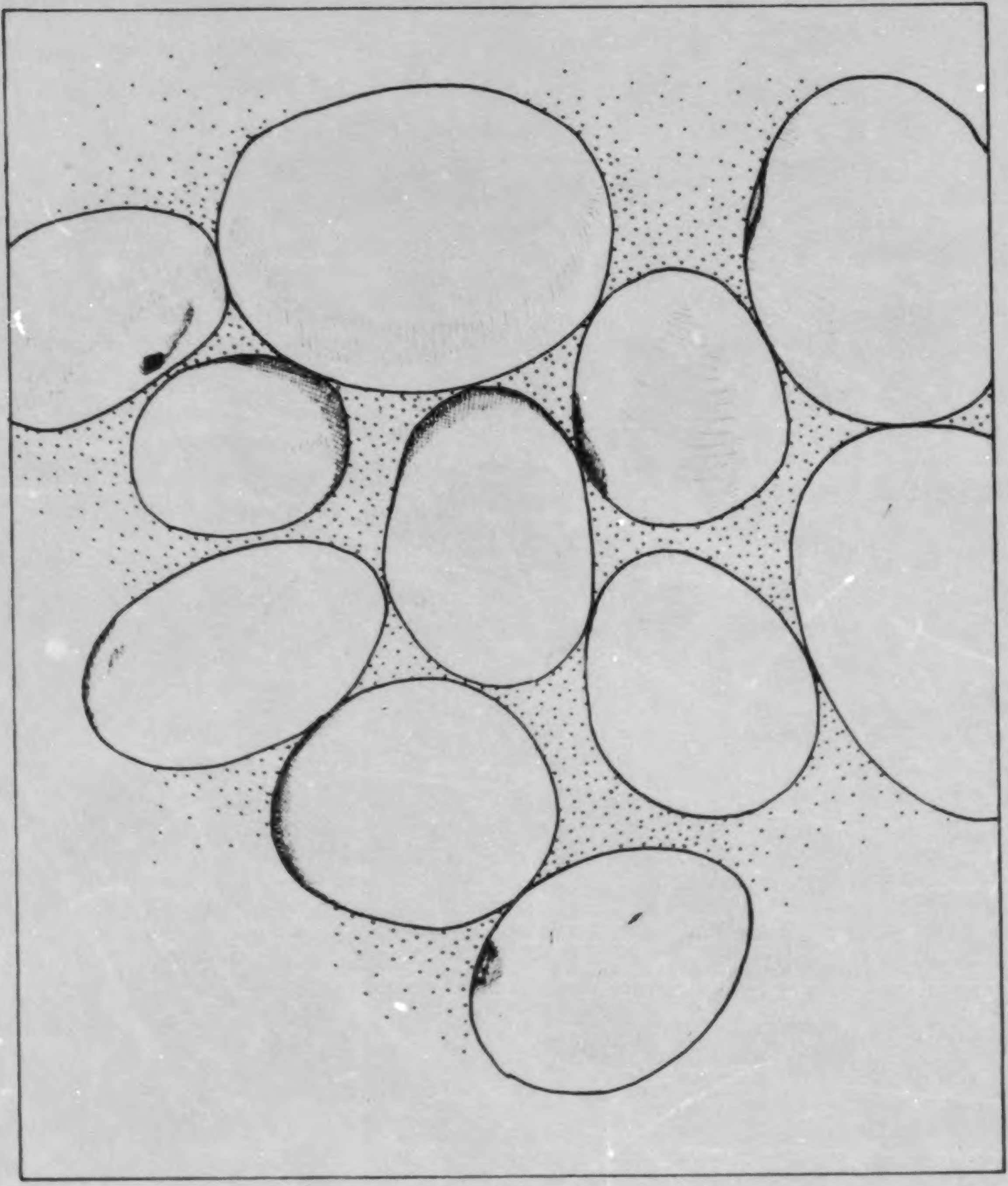
SOYBEAN PLANT BRANCHING



THE GROWER SHOULD ADJUST HIS PLANTING RATE TO THE VARIETY IN QUESTION. A VARIETY THAT BRANCHES PROFUSELY WHEN SPACED AT THE RATE OF 8 PLANTS PER FOOT OF ROW (RIGHT) WILL PRODUCE MORE BEANS AT THIS SPACING THAN IF CROWDED AT A RATE OF 12 OR 14 PLANTS (CENTER AND LEFT) PER FOOT OF ROW.

T-7

VARIATION IN SEED SIZE



THE VARIATION IN SEED SIZE MAY BE GREAT, EVEN WITHIN A SINGLE FIELD. THIS MAY CAUSE PLANTING RATES TO VARY.

SOYBEAN VARIETIES

Variety	Maturity Days	Seed Per Pound
HAROSOY^{63}	122	2480
AMSOY^{71}	124	2410
CORSOY	125	2850
BEESON	127	2370
WAYNE	134	2710
CALLAND	136	2440
WILLIAMS	140	2550

EFFECT OF PLANT POPULATION ON SOYBEAN YIELD

1971 10 - Inch Rows		1972 15 - Inch Rows	
Harvest Pop. /Acre	Yield Bu/Acre	Harvest Pop. /Acre	Yield Bu/Acre
64900	48. 4	42500	60. 3
114000	46. 7	77900	55. 4
198000	44. 2	113000	52. 8
240000	39. 8	156000	52. 2

T-10

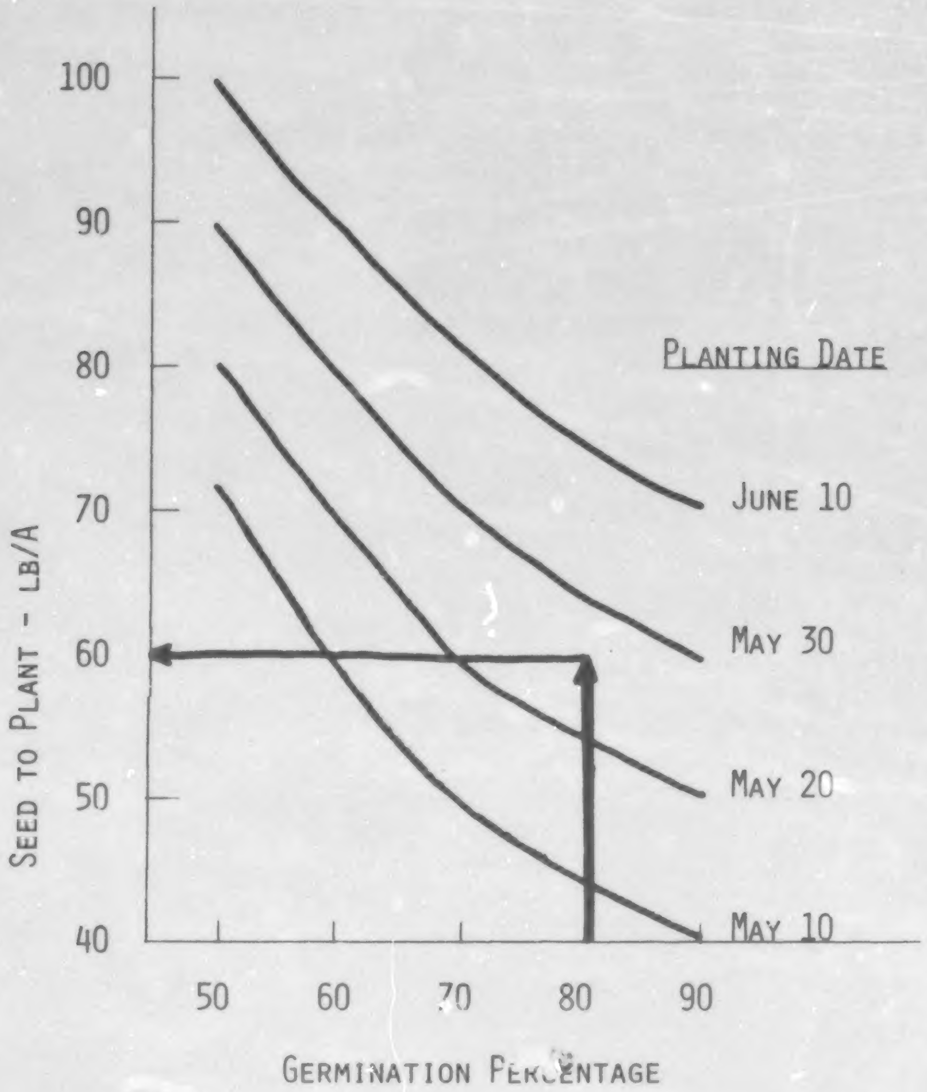
EFFECT OF ROW WIDTH AND PLANTING RATE

Seed Planted lb. /Acre	Number of Seeds/A	Emerged Population Per Acre	Population Per Acre Harvest	Soybean Yield Bu. /Acre
		20-Inch Row		
40	110000	89000	89000	51.4
55	155000	120000	108000	52.7
70	200000	165000	135000	54.4
		30-Inch Row		
40	110000	81000	68000	49.9
55	155000	97000	87000	49.9
70	200000	115000	108000	51.1

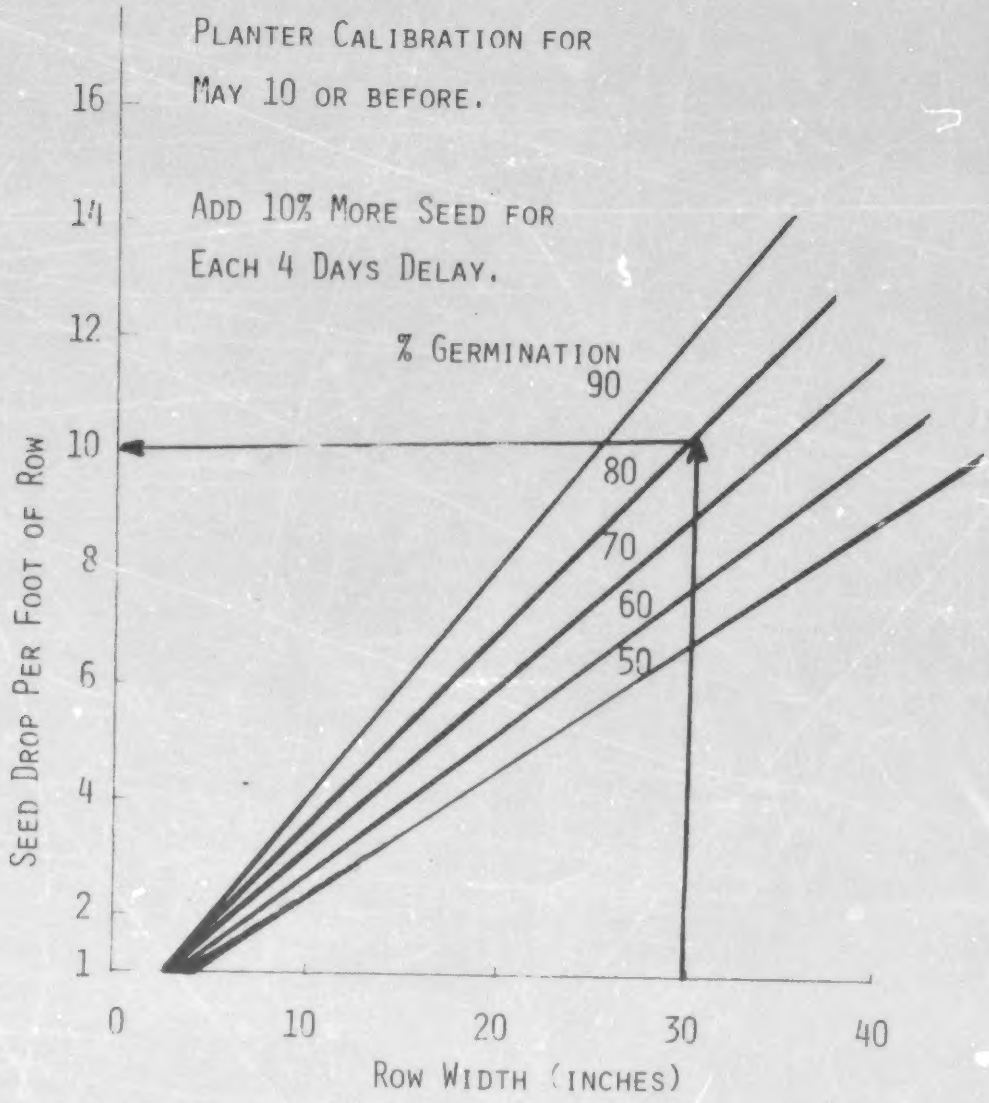
SUGGESTED SOYBEAN SEEDING RATE

DAYS TO MATURITY	PLANTING DATE	Row Width in Inches				
		7"	14"	20"	30"	40"
110-115	May 1-15	2.0	4.0	6.0	x	x
	May 16-25	2.5	5.0	7.0	x	x
116-130	May 1-15	1.5	3.5	4.5	6.0	x
	May 16-25	1.7	3.5	5.0	7.0	x
131-136	May 1-5	1.5	3.5	4.5	6.0	9.0
	May 16-25	1.7	3.5	5.0	7.0	x
137-150	May 1-5	1.5	3.5	4.5	6.0	x
	May 16-25	1.7	3.5	5.0	7.0	x

PLANTING DATE AND GERMINATION



Soybean planting guide. Determine the germination percentage of the seed to be planted, read upward to the planting date line, then to the left hand scale and read the approximate weight of seed to plant per acre. For example, seed that germinates 80%, to be planted on May 25, should be planted about 60 pounds to the acre. (Note that the curved lines are the planting date lines.)

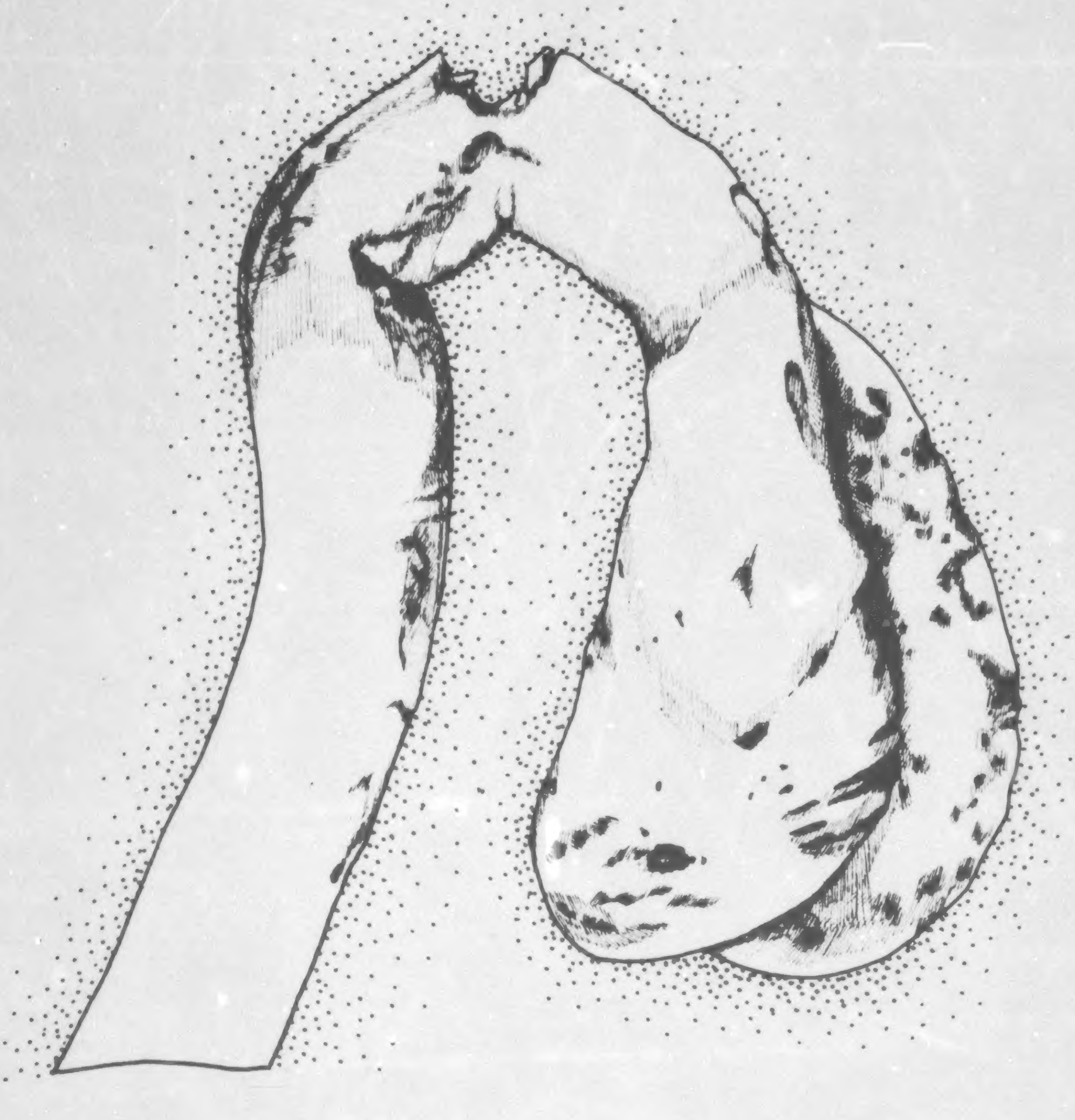


PLANTER CALIBRATION FOR MAY 10 OR BEFORE.

ADD 10% MORE SEED FOR EACH 4 DAYS DELAY.

PLANTER CALIBRATION GUIDE FOR MAY 10 PLANTING DATE. DETERMINE THE GERMINATION PERCENTAGE OF THE SEED TO BE PLANTED. READ UPWARD FROM THE ROW WIDTH TO BE USED TO THE APPROPRIATE GERMINATION LINE, THEN TO THE LEFT HAND SCALE AND READ THE SEED DROP PER FOOT OF ROW. ADD 10 PERCENT MORE SEED FOR EACH FOUR DAYS AFTER MAY 10 THAT THE SOYBEANS ARE PLANTED. FOR EXAMPLE, SEED THAT GERMINATES 60%, PLANTED IN 30-INCH ROWS SHOULD DROP 10 PER FOOT IF PLANTED BY MAY 10.

EFFECT OF DEEP PLANTING



A BROKEN HYPOCOTYL ARCH MAY BE CAUSED BY DEEP PLANTING, A CRUST, A COMPACTED SOIL, OR A COMBINATION OF THESE.

T-15

HOW TWO VARIETIES DIFFER IN EMERGENCE

VARIETY	PERCENT EMERGENCE AT THREE PLANTING DEPTHS		
	2 INCHES	3 INCHES	4 INCHES
AMSOY	91	68	6
CLARK	79	8	0

SOURCE: IOWA STATE UNIVERSITY

WEED CONTROL IN SOYBEANS

A RESOURCE UNIT FOR ADULT EDUCATION CLASSES IN AGRICULTURE

DEVELOPED BY
BOB STONE

EDITED BY
J. DAVID MCCRACKEN

DEPARTMENT OF AGRICULTURAL EDUCATION
COLLEGE OF AGRICULTURE AND HOME ECONOMICS
THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO 43210

1975

PREFACE

THIS RESOURCE UNIT WAS DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U. S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN ASSISTANT PROFESSOR	L. H. NEWCOMB ASSISTANT PROFESSOR

TABLE OF CONTENTS

	Page
Preface	III
Introduction	1
State Situation	3
Local Situation	3
Objectives	3
References	3
Needed AV Equipment	4
Alternative Interest Approaches	4
Questions to be Answered	4
Learning Activities	4
To Summarize (Note to Teacher) and Application	5
Appendix A: Content Summary	6
Appendix B: Instructional Materials	12

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR *TEACHER USE ONLY*. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATIBLE TO THE LOCAL COMMUNITY.

WEED CONTROL IN SOYBEANS

STATE SITUATION

SOYBEANS ARE NOT STRONG WEED COMPETITORS IN THE EARLY PART OF THE SEASON. WEED PROBLEMS IN SOYBEANS ARE A GREAT SOURCE OF YIELD LOSS. OHIO IS A MAJOR STATE IN SOYBEAN PRODUCTION. CONTROL OF WEEDS IN OHIO SOYBEAN FIELDS WOULD RESULT IN MILLIONS OF DOLLARS OF ADDITIONAL AGRICULTURAL INCOME AND LESS INCONVENIENCE IN HARVESTING.

LOCAL SITUATION

EACH TEACHER SHOULD BECOME THOROUGHLY FAMILIAR WITH LOCAL WEED PROBLEMS IN SOYBEANS, CURRENT HERBICIDE RECOMMENDATIONS, AND SOIL TYPES IN HIS COMMUNITY. IT IS RECOMMENDED THE TEACHER TAKE SLIDES OF VARIOUS WEEDS IN SOYBEAN FIELDS AND ALSO DISCUSS WEED CONTROL MEASURES USED BY LOCAL FARMERS.

OBJECTIVES

OBJECTIVES ARE FOR ADULTS TO:

1. IDENTIFY WEED SEEDLINGS COMMON IN SOYBEANS IN YOUR COMMUNITY.
2. PLAN A CULTURAL WEED CONTROL PROGRAM.
3. PLAN A CHEMICAL WEED CONTROL PROGRAM.

REFERENCES

CROPS AND SOIL MAGAZINE. AUGUST - SEPTEMBER, 1974.

CURRENT AGRONOMY GUIDE. COOPERATIVE EXTENSION SERVICE, THE OHIO STATE UNIVERSITY.

SCOTT AND ALDRICH. MODERN SOYBEAN PRODUCTION. THE FARM QUARTERLY, CINCINNATI, OHIO: 1970.

SELECTIVITY OF SPECIFIC HERBICIDES. AGRONOMIC TIPS, DEPARTMENT OF AGRONOMY, THE OHIO STATE UNIVERSITY. JANUARY, 1974, W-17.

SOME IDENTIFYING CHARACTERISTICS OF 70 CROP AND WEED PLANTS (SLIDES). AGDEX 100/40 OHIO CURRICULUM MATERIALS SERVICE.

WEED CONTROL - CULTURAL AND CHEMICAL. MANUAL 1969. OHIO CURRICULUM MATERIALS SERVICE, AGDEX 641.

WEED IDENTIFICATION GUIDE. INDIANAPOLIS, INDIANA: ELANCO PRODUCTS COMPANY, 1973 (REPRINTED FROM AMOCO OIL COMPANY PESTICIDE HANDBOOK).

NEEDED AV EQUIPMENT

WEED MOUNTS OR ACTUAL MATURE WEEDS, SLIDE PROJECTOR AND SCREEN, OVERHEAD PROJECTOR, AND CHALKBOARD.

ALTERNATIVE INTEREST APPROACHES

ALTERNATIVE A. IDENTIFY LOCAL PROBLEM, ASSESS THE PROBLEM, GET RESPONSES FROM THE CLASS, AND THEN SHOW A SURVEY OF SOYBEAN FIELDS IN THE COMMUNITY AND COMPARE OBSERVATIONS (SEE SURVEY FORM AS HANDOUT #1).

ALTERNATIVE B. START OUT WITH A TITLE SUCH AS - WEED CONTROL IN CONTINUOUS SOYBEANS. CREATE DOUBT OF CONTINUOUS SOYBEANS THEN LEAD INTO PROBLEMS FACED; I.E., CONTINUOUS SOYBEAN MAGNIFY WEED PROBLEMS, DISEASE PROBLEMS, AND MAYBE INSECT PROBLEMS. (HOW WEEDS, INSECTS AND DISEASES SPREAD.)

ALTERNATIVE C. WHAT WEEDS CAN YOU LIVE WITH? WHICH ONES SLOW COMBINE OPERATIONS? WHICH ONES CREATE THE GREATEST HARVEST LOSSES?

QUESTIONS TO BE ANSWERED

1. WHAT WEEDS WILL YOU NEED TO CONTROL IN YOUR SOYBEAN FIELDS THIS YEAR?
2. WHAT CULTURAL METHODS WILL YOU USE IN YOUR WEED CONTROL PROGRAM?
3. HOW CAN HERBICIDES BE EFFECTIVELY USED TO CONTROL WEEDS?

LEARNING ACTIVITIES

1. WHAT WEEDS WILL YOU NEED TO CONTROL IN YOUR SOYBEAN FIELDS THIS YEAR?

USE THE SLIDE SERIES IN THE REFERENCE LIST, PLANT MOUNTS AND ACTUAL WEEDS TO IDENTIFY COMMON WEED PROBLEMS. DISCUSS THE SEEDLING STAGE OF GROWTH BY USING THE WEED IDENTIFICATION GUIDE. EMPHASIZE THAT EARLY IDENTIFICATION OF POTENTIAL WEED PROBLEMS CAN RESULT IN CONTROLLING THE PROBLEM.

DISCUSS HOW WEEDS CAN INFEST CROP FIELDS FROM OTHER AREAS.

2. WHAT CULTURAL METHODS WILL YOU USE IN YOUR WEED CONTROL PROGRAM?

USE TRANSPARENCY #1 TO DISCUSS THE RELATIONSHIP OF SOYBEAN HEIGHT AND WEED DAMAGE.

Utilize transparencies #2-4 to discuss the effect of narrow rows on weed control.

Discuss the mechanical control methods available to control weeds. Emphasize the optimum use of these methods:

1. Disking
2. Harrowing
3. Rotary Hoe
4. Cultivating

3. How can herbicides be effectively used to control weeds?

Use the Agronomy Guide and handout #2 to discuss current chemical recommendations.

Use handout #3 to discuss timeliness of application:

1. Pre-emergence
2. Post-emergence
3. Cracking stage

To Summarize (Note to teacher) and Application

1. Identify the weed problem early.
2. Apply cultural or chemical controls according to recommended directions.
3. Harvest weed-free soybeans on time.
4. Charge all others more $/Acre for harvesting weedy soybeans.

APPENDIX A

CONTENT SUMMARY

1. WEED CONTROL IN SOYBEANS
    - A. KILL WEEDS EARLY
    - B. PLANT IN NARROW ROWS
    - C. THE VALUE OF GOOD SEED
    - D. CROP ROTATION
    - E. MECHANICAL WEED CONTROL MEASURES
    - F. CHEMICAL WEED CONTROL
2. DRYING RATE OF SOYBEANS FOLLOWING PARAQUAT TREATMENT
    - A. SITUATION
    - B. RESULTS
    - C. SUMMARY
    - D. SUGGESTIONS
3. WEED IDENTIFICATION GUIDE

WEED CONTROL IN SOYBEANS[1]

SOYBEANS ARE NOT STRONG WEED COMPETITORS IN THE EARLY PART OF THE SEASON.

THE GROWER MUST HAVE AN UNDERSTANDING OF THE PRINCIPLES OF WEED CONTROL TO MAKE WISE USE OF HERBICIDES.

KILL WEEDS EARLY

WEED COMPETITION IS NOT A SERIOUS THREAT TO SOYBEAN YIELDS IF THE WEEDS ARE REMOVED BY THE TIME THE SOYBEANS REACH THE FLOWERING STAGE. THIS MIGHT SUGGEST THAT EARLY WEED CONTROL IS NOT IMPORTANT. CURRENTLY-USED CONTROL METHODS ARE MORE EFFECTIVE AND ECONOMICAL ON SMALL WEEDS THAN LARGE ONES. THEREFORE, SOYBEAN WEED CONTROL PRACTICES IN MOST CASES SHOULD BE CONCENTRATED IN THE EARLY PART OF THE SEASON.

WEEDS, IF LEFT AFTER MIDSEASON, SERIOUSLY AFFECT YIELDS. IN SOME SEASONS, A POUND OF SOYBEAN DRY MATTER (WEIGHT OF STEMS, LEAVES, AND BEANS) MAY BE LOST FOR EVERY POUND OF WEED DRY MATTER PRODUCED.

WEEDS THAT GERMINATE AFTER THE CROP SHADES THE GROUND MAY NOT SURVIVE. IF THEY DO LIVE, THEY USUALLY AFFECT YIELD ONLY TO THE EXTENT THAT THEY CONTRIBUTE TO HARVEST LOSS.

PLANT IN NARROW ROWS

UNFORTUNATELY, NARROW ROWS DO NOT CONTRIBUTE TO EARLY SEASON WEED CONTROL. THEY MAY COMPLICATE MECHANICAL CONTROL BECAUSE NARROW ROWS ARE DIFFICULT TO CULTIVATE. THERE ARE MORE LINEAR FEET OF ROW PER ACRE IN NARROW ROWS. THE LEAF CANOPY OF NARROW ROW SOYBEANS DOES COVER THE AREA BETWEEN ROWS MORE QUICKLY THAN THAT OF SOYBEANS IN 36- TO 40-INCH ROWS. ONCE THE CANOPY IS DEVELOPED, THE SHADE IS QUITE DENSE. LATE-GERMINATING WEEDS SUCH AS GIANT FOXTAIL, WHICH ARE NOT SHADE-TOLERANT, DO POORLY OR DIE. EVEN THE MORE SHADE-TOLERANT WEEDS SEEM TO LOSE VIGOR.

THE VALUE OF GOOD SEED

A UNIFORM STAND OF VIGOROUS SEEDLINGS WILL HELP SHADE OUT THE EARLY AND LATE-SEASON WEEDS. FAST-GROWING SEEDLINGS ALSO GET A HEADSTART, PROVIDING THE NECESSARY HEIGHT DIFFERENTIAL FOR EFFECTIVE USE OF CULTIVATION.

IOWA STATE RESEARCHERS REPORT THAT WEED POPULATION INCREASES AS THE NUMBER OF SOYBEAN PLANTS PER FOOT OF ROW DECREASES. GOOD SEED QUALITY

---

[1] CONDENSED FROM SCOTT AND ALDRICH, MODERN SOYBEAN PRODUCTION. THE FARM QUARTERLY, CINCINNATI, OHIO: 1970.

AND UNIFORM PLANTING DEPTH HELP TO GIVE UNIFORM STANDS FREE OF GAPS. SEEDLINGS FROM DEEP-PLANTED SEED GROW MORE SLOWLY IN THEIR EARLY LIFE THAN THOSE FROM SEED PLATNED ONLY 1 TO 1 1/2 INCHES DEEP.

CROP ROTATION

ROTATING CROPS - AND, THEREFORE, HERBICIDES - OFTEN ENABLES THE GROWER TO MATCH THE HERBICIDE OR MECHANICAL CONTROL METHOD TO A SPECIFIC WEED PROBLEM. FOR EXAMPLE, ONE WAY TO REDUCE A COCKLEBUR OR MORNING-GLORY PROBLEM IS TO PLANT THE FIELD TO CORN, USING POST-EMERGENCE 2, 4-D SPRAY. SOYBEANS CAN BE PLANTED THE FOLLOWING YEAR WITH LESS COCKLEBUR OR MORNING-GLORY TROUBLES.

IN THE NORTHERN SOYBEAN AREA, ESTABLISHED QUACKGRASS IS KILLED BY FALL APPLICATION OF ATRAZINE. SINCE SOYBEANS ARE SUSCEPTIBLE TO THIS CHEMICAL, CORN IS THE FIRST CROP GROWN AFTER TREATMENT. AFTER THE QUACKGRASS POPULATION HAS BEEN REMOVED, RE-ESTABLISHMENT OF THE WEED PEST FROM SEED CAN USUALLY BE PREVENTED BY USING APPROPRIATE SOYBEAN PRE-EMERGENCE HERBICIDES.

MECHANICAL WEED CONTROL MEASURES

THERE IS LITTLE ADVANTAGE TO DISKING OR HARROWING MORE THAN ONCE BEFORE PLANTING TO KILL ANNUAL WEEDS. DISKING KILLS THE CROP OF WEEDS THAT ARE GROWING BUT IT ALSO BRINGS UNGERMINATED WEED SEED TO THE SURFACE. ALSO, IN SOME AREAS, IT CAUSES THE LOSS OF PRECIOUS SOIL MOISTURE.

IF PERENNIAL WEEDS ARE THE PROBLEM, THEY SHOULD BE ALLOWED TO GROW ONE OR TWO WEEKS BEFORE DISKING. THE EARLY WEED GROWTH IS MADE AT THE EXPENSE OF FOOD RESERVES STORED IN THE ROOTS. KILLING THE TOP GROWTH OF THE SMALL PERENNIAL WEED WILL WEAKEN ITS RESERVES.

ROTARY HOEING: THE ROTARY HOE IS A VERY GOOD WEED CONTROL TOOL FOR USE IN SOYBEANS. SUCCESS WITH THIS IMPLEMENT DEPENDS PRIMARILY ON TIMELINESS AND SPEED OF OPERATION. THE BEST TIME TO USE THE ROTARY HOE IS AFTER WEED SEEDS HAVE GERMINATED BUT BEFORE THE MAJORITY OF THE WEEDS HAVE EMERGED. THE WEEDS MUST BE VERY SMALL TO BE CONTROLLED SUCCESSFULLY BY THIS IMPLEMENT. THE OBJECTIVE IS TO THROW THE SHALLOW-ROOTED WEED OUT OF THE GROUND OR TO DISTURB THE SOIL AROUND IT ENOUGH TO INTERFERE SERIOUSLY WITH WATER UPTAKE.

THE SOYBEAN SEEDLINGS, WHICH ARE MORE DEEPLY ROOTED THAN THE WEEDS, ARE NOT DAMAGED SEVERELY BY THE ROTARY HOE. SOYBEANS SHOULD BE ALLOWED TO LOSE THEIR EARLY MORNING TURGIDITY BEFORE ROTARY HOEING BEGINS. A BRIGHT, WARM DAY ALSO IMPROVES THE EFFECT OF HOEING BY INCREASING THE WILTING OF THE WEEDS.

SWEEP CULTIVATION: WHEN CULTIVATION IS NECESSARY TO CONTROL WEEDS THE CULTIVATOR SHOULD BE SET TO RUN SHALLOW. THIS IS PARTICULARLY TRUE AFTER THE SOYBEANS ARE 8 TO 10 INCHES TALL. THE MAJORITY OF THE SOYBEAN ROOTS ARE IN THE SURFACE 12 INCHES OF THE SOIL. DR. R. L. MITCHELL OF

Iowa State University reports that lateral roots under Iowa conditions reach the center of 30-inch rows within five to six weeks after planting.

Chemical Weed Control

Chemical control may start with a preplant application of a preemergence herbicide. Preplant herbicides are normally broadcast and worked into the soil before planting. Some are volatile and will be lost if left on the surface. Some are photosensitive and must be protected from the effect of the sun.

Incorporated herbicides are usually less dependent on rainfall after application than those applied on the surface. The success of both types of chemicals is influenced by such factors as soil type, soil moisture, and rainfall.

The effectiveness of some herbicides is influenced by the organic matter content of the soil. As a result of this, an application rate that causes crop injury in one field may fail to control weeds elsewhere.

Cooperative Extension Service
The Ohio State University
Farm Machinery No. 8
August, 1973

Drying Rate of Soybeans Following Paraquat Treatment

Situation

The Chippewa 64 soybeans at the 1972 Farm Science Review Site appeared to be too wet and green to harvest for the scheduled field demonstrations on September 19, 20, and 21. Samples collected on September 13 revealed that bean moisture in the driest part of the field (high ground) was 26%, while beans from the rest of the field were too wet to measure - or in excess of 34%.

The beans were treated with Paraquat[2] at 5 p.m. on September 15. The paraquat was flown on at the rate of 1 pint per acre in 5 gallons of water x 77 (wetting agent) was added to the spray solution at the rate of 1 quart per 100 gallons of water. Moisture samples of the soybeans were collected thereafter until the harvest at the Farm Science Review program was completed.

---

[2] Paraquat dichloride, 2 lb. paraquat cation per gallon.

Results

Moisture readings of beans collected from different areas of the field were as follows:

Date	Driest area in field (4 acres)	Rest of field (46 acres)
Sept. 13, 1972	26%	+ 34%*
Sept. 14	Rain	Rain
Sept. 15, 5:00 P.M.	Application of Paraquat	
Sept. 16, 5:00 P.M.	19.2%	34%
Sept. 17, 5:00 P.M.	14.0%	26%
Sept. 18 (Rain)	16.6%	Rain
Sept. 19**	–	18.6
Sept. 20**	–	16.6
Sept. 21**	–	15.0

*Beans too wet to get reading.
**Bean samples harvested by combines from wettest area of field.

Summary

Assuming that the soybeans were still at about the same moisture on September 15 as on September 13 because of the rain on September 14, then the Paraquat treated soybeans from the most mature part of the crop dried at the rate of about 3.1% per day, 26% to 16.6% in three days. Likewise, the beans from the least mature (or wettest and weediest) part of the field dried at the rate of about 3.2% per day, 34% to 15% in six days.

On September 18 it rained all day. So, prior to that date, the beans were drying at the rate of about 6% per day in both areas of the treated field.

The slower rate of drying shown for September 20 and 21 may be less than expected because the grain moisture samples were taken from areas of the field that had progressively heavier infestations of weeds and the beans were less mature. Also, these samples were taken from the combine grain tank which would reflect the "pick up of bean moisture" due to combining.

Taking into account that the Chippewa 64 soybeans treated with Paraquat dried at a rate of 3 to 6% per day, 4% per day may be a very useful figure to use in predicting harvesting dates after treatment.

How does this drying rate compare with the normal drying rate of untreated soybeans? Data gathered by Lamp, Johnson, Harkness and Smith reveal the following:

BEAN VARIETY	DRYING RATE
MONROE	0.8%/DAY
HAROSOY	1.3%/DAY
LINCOLN	1.1%/DAY
HAWKEYE	1.8%/DAY

THIS SUGGESTS THAT THE USE OF PARAQUAT MAY NEARLY DOUBLE THE NORMAL RATE OF DRYING. THIS, OF COURSE, ASSUMES GOOD DRYING WEATHER WITH NO MORE THAN ONE DAY OF RAIN DURING THE DRY-DOWN PERIOD.

THE EARLIER HARVEST, MADE POSSIBLE BY THIS PARAQUAT TREATMENT, MAY BE OF VALUE TO SOYBEAN SEED PRODUCERS WHO WANT TO HARVEST THE CROP EARLY - BEFORE DRY-DOWN AND REWETTING OCCURS. ALSO, FARMERS WANTING TO FOLLOW SOYBEANS WITH WHEAT MAY FIND THIS PRACTICE BENEFICIAL.

SUGGESTIONS

EXTENSION AGENTS AND VOCATIONAL AGRICULTURE TEACHERS HAVE, ON OCCASIONS, USED PARAQUAT EXPERIMENTALLY AS A HARVESTING AID IN WEEDY SOYBEANS. A HELPFUL PROCEDURE WOULD BE TO USE A CANVAS TARP OR PLASTIC SHEET OVER SOME REPRESENTATIVE SPOTS IN THE FIELD AT THE TIME OF APPLICATION SO THAT THE BEANS UNDERNEATH COULD BE USED AS CONTROL PLOTS. THEN, IF MOISTURE TESTS WERE TAKEN EACH DAY ON BEANS FROM THE TREATED AREA AS WELL AS THE CONTROL PLOTS, MORE ACCURATE INFORMATION COULD BE GAINED AS TO THE RATE OF DRYING FOR A NUMBER OF DIFFERENT VARIETIES OF SOYBEANS. IF THIS IS DONE, PLEASE SHARE THE RESULTS WITH THE AUTHORS. IT IS IMPORTANT THAT THE SOYBEANS BE ESSENTIALLY PHYSIOLOGICALLY MATURE BEFORE PARAQUAT IS APPLIED OR THE QUALITY WILL BE REDUCED. AT LEAST ONE-HALF OF THE LEAVES SHOULD HAVE DROPPED BEFORE APPLICATION.

DR. EDWARD STROUBE
EXTENSION AGRONOMIST

DELBERT M. BYG
EXTENSION AGRICULTURAL ENGINEER

APPENDIX B

INSTRUCTIONAL MATERIALS

HANDOUTS

H-1: COMMUNITY SURVEY

H-2: SELECTIVITY OF SPECIFIC HERBICIDES

H-3: CRACKING STAGE TREATMENT FOR BROADLEAF WEEDS

TRANSPARENCIES

T-1: EFFECTS OF REMOVING FOXTAIL FROM SOYBEANS

T-2: SHADING SURPRESSES FOXTAIL IN SOYBEANS

T-3: DAYS AFTER PLANTING BEFORE CANOPY COVERS INTER-ROW AREA

T-4: SOYBEAN STAND EFFECTS ON WEED POPULATION

Community Survey

ASSESS THE PROBLEM

(Do for 100 samples)

Identification Number of Samples ___

Initials ______

Condition of Soybeans

a. Tall ______ Med ______ Short ______

b. Standing __________ Stooping __________

Know your enemy!	Many	Med	Few or none	
1. Corn				Will the corn make enough grain to interfere with soybean quality yes__ no__
2. Jimson Weed				
3. Lambsquarter				
4. Pigweed				
5. Common Ragweed				
6. Giant Ragweed				
7. Foxtail				
8. Velvet Leaf or Button Weed				
9. Cocklebur				
10. Canada Thistle				
11. Smart Weed				

SELECTIVITY OF SPECIFIC HERBICIDES*

Herbicides vary greatly in their effectiveness on different weed species. It is important to know these differences and to preduct the species of weeds in a field when selecting a herbicide. The following table has general comparative ratings based on field observations. With favorable weather conditions, control may be better than indicated and with unfavorable conditions control may be less than indicated.

Herbicides for use on SOYBEANS	Treflan or Planavin or Cobex[1]	Vernam[1]	Amiben	Lasso	Lorox or Maloran or Bromex	Lasso + Lorox or Lasso + Maloran or Lasso + Bromex	Sencor or Lexone[2]	Lasso + Sencor or Lexone[2] Treflan + Sencor or Lexone[3]	CIPC[4]	2,4-DB[5]	Tenoran or Norex[5]	Basagran[6]
Soybean tolerance	G	F	G	G	F	G	F	F-G	G	F	F	G
Grasses												
Giant foxtail	G	G	G	G	F-G	G	F-G	G	P-F	P	P	P
Green foxtail	G	G	G	G	F-G	G	F-G	G	P-F	P	P	P
Yellow foxtail	G	G	G	G	F-G	G	F-G	G	P-F	P	P	P
Barnyardgrass	G	G	G	G	F-G	G	F-G	G	P-F	P	P	P
Fall panicum	G	F-G	F	G	F-G	F-G	F-G	F-G	P-F	P	P	P
Crabgrass	G	F-G	G	G	G	G	F-G	G	P-F	P	P	P
Johnsongrass (seedlings)	G	F-G	F	F	P	P-F	P	P	P	P	P	P
Yellow nutsedge	P	F	P	F[7]	P	P-F	P	P-F	P	P	P	F-G
Broadleafs												
Cockelbur	P	P	P	P	P	P-F	F-G	F	P	G	F	G
Lambsquarters	F	F	G	F	G	G	G	G	P	P	F	G
Mustard	P	P	P-F	F	G	G	G	F-G	P-F	P	F	G
Pigweed	F	F	G	G	G	G	G	G	P-F	P	G	G
Annual Morning-glory	P-F	P-F	P	P	P	P	-	P	P	F	F	-
Ragweed	P	P	G	P	G	G	G	G	P	P	F	G
Smartweed	P	P	G	P-F	F-G	G	G	G	G	P	F	G
Velvetleaf	P	P	F	P	F	F	G	F-G	P	P	P	G
Jimsonweed	P	P	P	P	F	P-F	G	F-G	P	P	F	G

G - Good   F - Fair   P - Poor

---

*Agronomic Tips, Department of Agronomy, The Ohio State University, January, 1974, W-17 (revised).

[1] Treflan, Planavin, Cobex and Vernam must be incorporated into the soil.

[2] Sencor or Lexone are new materials and rates are critical. These materials have been observed only 3 years.

[3] Treflan must be incorporated into the soil with Sencor or Lexone applied on the soil surface after planting.

[4] CIPC at rates of 2 to 3 lb/A will primarily control only smartweed. It may be used as an overtreatment or combined with several of the other herbicides.

[5] Tenoran, Norex and 2,4-DB must be applied post-emergence. Timing of application is critical. Do not apply 2,4-DB when soybeans show symptoms of Phytophthora root rot.

[6] Basagran must be applied post-emergence when weeds are no more than 4 inches tall. Cocklebur may be 6 to 8 inches tall. Basagran has been observed only 2 years.

CRACKING STAGE TREATMENT FOR BROADLEAF WEEDS

WHEN TO APPLY

The ideal time to spray is during the cotyledon stage before the first true leaves open and expose the terminal bud.

APPLICATION

Use 2 to 3 quarts of PREMERGE in 3 to 5 gallons of water applied by aircraft or in about 30 gallons of water applied by ground equipment. Select rate according to the following table:

Temperature	Quarts
Below 75° F	3
75° F to 95° F	2
Over 95° F	Do Not Apply

With either method of application, add 2 quarts agricultural surfactant per 100 gallons of spray.

Use a spray volume of 10 to 30 gallons per acre. For low spray volumes, such as 10 gallons per acre, use high pressure (60-75 psi) and fine spray tips (such as Spraying Systems TX6), raise boom 40 inches above the ground and cover the field uniformly. For higher spray volumes, use 30 to 40 psi pressure with 8002 or 8004 spray tips and apply to thoroughly wet all weeds.

Use a spray volume of 3 to 5 gallons per acre. Spray nozzles should be properly spaced and adjusted to provide uniform coverage across the entire swath width.

PERMERGE kills most seedling broadleaf weeds on contact including:

- cocklebur
- annual morning-glory
- teaweed
- coffeebean (Sesbania)
- ragweed
- wild sunflower
- pigweed
- smartweed
- jimsonweed
- velvetleaf (buttonweed)
- wild mustard
- purslane

Avoid spraying when Soybeans are drought stressed, the soil surface is visibly wet, Soybeans leaves have opened, or air temperature is over 95° F.

ATTENTION

Read and observe all handling precautions on PREMERGE Dinitro Weed Killer label before using. Some temporary injury to soybeans may occur, but crop yield is ordinarily not reduced.

EFFECT OF REMOVING FOXTAIL FROM SOYBEANS

SOYBEAN HEIGHT WHEN FOXTAIL WAS REMOVED (INCHES)	AVERAGE YIELD (BUSHELS PER ACRE)
WEED-FREE CHECK	30
8	30
12	30
16	29
22	28
LEFT UNTIL BEANS WERE MATURE	12

UNIVERSITY OF ILLINOIS

SHADING SUPPRESSES FOXTAIL IN SOYBEANS

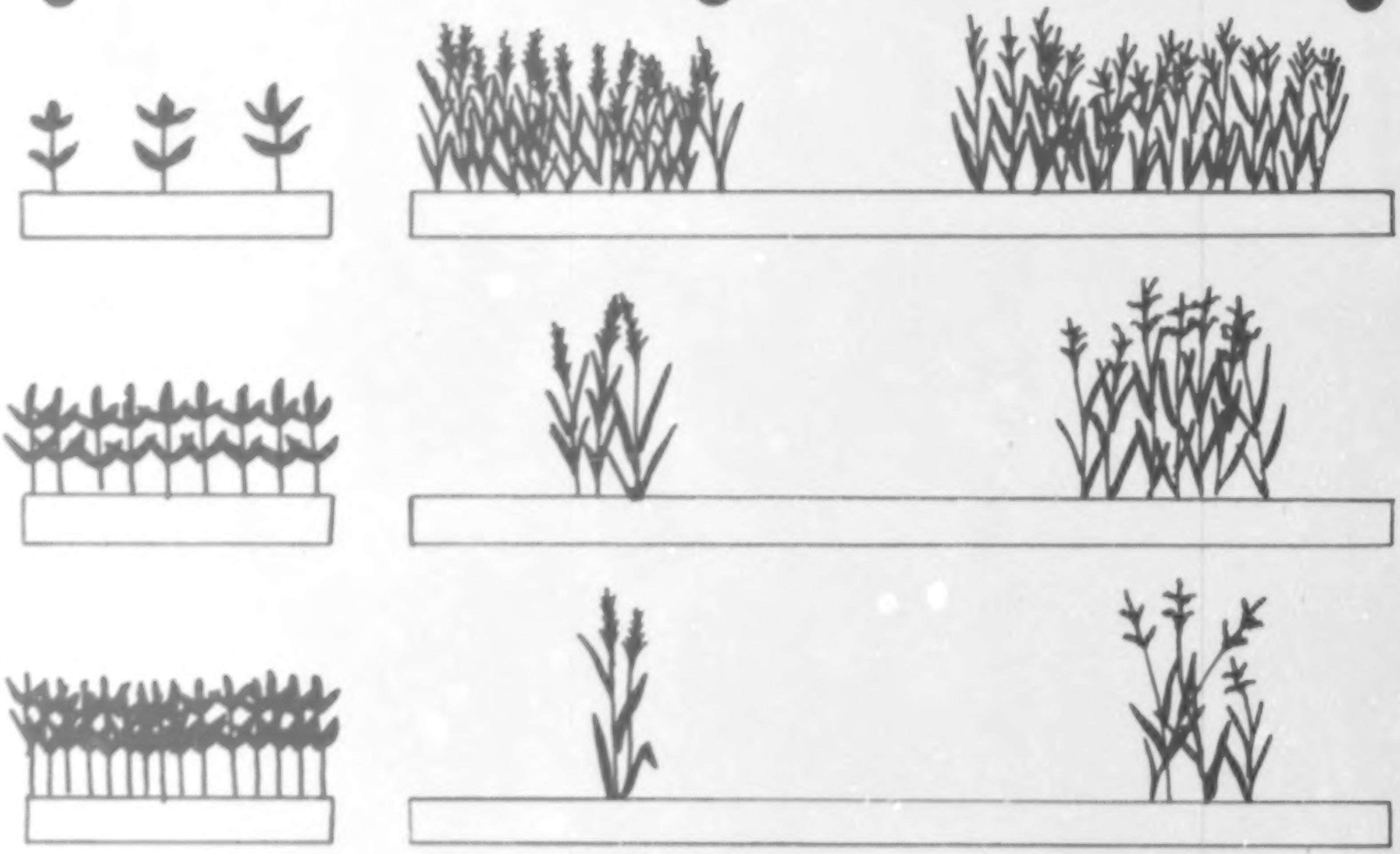
TIME FOXTAIL WAS SEEDED AFTER CROP WAS PLANTED	TOTAL DRY MATTER PRODUCED (POUNDS PER ACRE)	
	FOXTAIL	SOYBEANS
SAME DAY	2,280	3,970
3 WEEKS	30	5,240
6 WEEKS	0	5,390
12 WEEKS	0	5,440
WEED-FREE	0	5,410

T-2

DAYS AFTER PLANTING BEFORE CANOPY COVERS INTER-ROW AREA

Row width (inches)	Number of days
40	67
30	58
20	47
10	36

University of Nebraska



A thin stand of soybeans favors a heavy population of weeds in the crop row. The relative populations of giant foxtail and smartweed plants are shown for stands of 3, 9 and 15 soybean plants per foot or row. In an effort to get a measure of the value of crop shading, researchers used no herbicide in these comparison plots.

T-4

Adult Unit No. 4

CORN AND SOYBEAN HARVEST LOSSES

A Resource Unit For Adult Education Classes in Agriculture

Developed by
James Moorman

Edited by
L. H. Newcomb

Department of Agricultural Education
College of Agriculture and Home Economics
The Ohio State University
Columbus, Ohio 43210

1975

PREFACE

THIS RESOURCE UNIT WAS DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U. S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN ASSISTANT PROFESSOR	L. H. NEWCOMB ASSISTANT PROFESSOR

TABLE OF CONTENTS

PAGE

PREFACE III

INTRODUCTION 1

STATE SITUATION 3

LOCAL SITUATION 3

OBJECTIVES 3

REFERENCES 3

NEEDED AV EQUIPMENT 4

ALTERNATIVE INTEREST APPROACHES 4

QUESTIONS TO BE ANSWERED 4

LEARNING ACTIVITIES 4

TO SUMMARIZE (NOTE TO TEACHER) 6

APPLICATION 6

APPENDIX A: CONTENT SUMMARY 7

APPENDIX B: INSTRUCTIONAL MATERIALS 13

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATIBLE TO THE LOCAL COMMUNITY.

CORN AND SOYBEAN HARVEST LOSSES

STATE SITUATION

TOTAL MACHINE LOSSES CAN BE EXCESSIVE. CORN HARVEST LOSSES FROM OCTOBER 8 TO DECEMBER 1 RANGED FROM 2.2 BUSHELS TO 29.4 BUSHELS PER ACRE. DELAYED HARVESTING LOSSES RANGED FROM 5.2 TO 50 BUSHELS PER ACRE. THESE FIGURES SUGGEST A NEED TO MAKE FARMERS AWARE OF THE POTENTIALLY HIGH LOSSES.

LOCAL SITUATION

CHECK AND RECORD HARVEST LOSSES OF LOCAL FARMERS TO ESTABLISH THE HARVEST LOSS RANGE AND AVERAGE FOR YOUR AREA.

OBJECTIVES

1. THE STUDENT FARM OWNER-OPERATOR WILL BE ABLE TO CALCULATE THE DOLLAR VALUE OF HIS HARVEST LOSSES, AND WILL REALIZE THAT BY MAKING MINOR ADJUSTMENTS HE CAN ADD CONSIDERABLY TO HIS OVERALL NET INCOME.
2. THE STUDENT WILL MEASURE HARVEST LOSSES.
3. THE STUDENT WILL DETERMINE THE CAUSE OF SUCH LOSSES.
4. THE STUDENT WILL CORRECT THE LOSS EITHER THROUGH MACHINE ADJUSTMENT OR DRIVING HABITS.

REFERENCES

A GUIDE TO BETTER COMBINING. TRAINING DEPARTMENT FORD TRACTOR, #FT015032 (NOVEMBER, 1969).

BEASLEY, E. O. INCREASING THE EFFICIENCY OF FIELD MACHINERY. NORTH CAROLINA AGRICULTURAL EXTENSION SERVICE, FEBRUARY, 1971, FOLDER #294.

BYG, DELBERT M. A GUIDE FOR MEASURING CORN HARVEST LOSSES. COLUMBUS, OHIO: THE OHIO STATE UNIVERSITY, PUBLICATION #AED 108.

BYG, DELBERT M. A GUIDE FOR MEASURING SOYBEAN HARVEST LOSSES. COLUMBUS, OHIO: THE OHIO STATE UNIVERSITY, PUBLICATION #EA-9087.

BYG, D. M. AND GILL, W. E. MACHINE LOSSES IN HARVESTING EAR AND SHELLED CORN. COLUMBUS, OHIO: THE COOPERATIVE EXTENSION SERVICE, THE OHIO STATE UNIVERSITY, 1965. (#MM268).

COMBINES AND COMBINING. THE OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, THE OHIO STATE UNIVERSITY, 1970.

CORN HARVESTING - HANDLING - MARKETING IN OHIO. COLUMBUS, OHIO: COOPERATIVE EXTENSION SERVICE, THE OHIO STATE UNIVERSITY. (BULLETIN #502)

LAMP, B. J.; JOHNSON, W. H.; HARKNESS, K. A.; SMITH, P. E. SOYBEAN HARVESTING. WOOSTER, OHIO: OHIO AGRICULTURAL EXPERIMENT STATION. RESEARCH BULLETIN #899, JANUARY, 1962.

NEEDED AV EQUIPMENT

16 MM SOUND MOVIE PROJECTOR AND OVERHEAD PROJECTOR.

ALTERNATIVE INTEREST APPROACHES

ALTERNATIVE A. HAVE A 10 SQ. FT. AREA MARKED OFF IN BACK OF ROOM WITH 40 BEANS OR 20 KERNELS OF CORN IN IT (EQUALS 1 BU. LOSS PER ACRE). LEAD A DISCUSSION TO SEE IF THE CLASS HAS ANY IDEA WHAT THIS LOSS WOULD COST? WITHOUT GETTING INTO DETAILS (AT THIS POINT) PROJECT THAT AT THIS RATE A FARMER WITH 100 ACRES OF BEANS @ $9 PER BU. WOULD LOSE ENOUGH TO BUY _________ (WHATEVER $900 WILL BUY--PICK SOMETHING APPROPRIATE TO YOUR GROUP).

ALTERNATIVE B. USING THE SAME IDEA AS IN ALTERNATIVE A, QUESTION THE GROUP AS TO WHETHER THEIR HARVESTED GROUND HAS THAT MANY BEANS OR KERNELS. AS THEY BEGIN TO PONDER, TOSS SOME FODDER, ETC. ON THE AREA TO CAMOUFLAGE IT AS IT IS IN THE FIELD. THIS SHOULD HELP THE CLASS REALIZE THAT THEIR LOSSES WILL NOT BE SO EASILY DETECTED AS THE GRAINS ORIGINALLY ON THE FLOOR WHEN YOU STARTED DISCUSSION.

QUESTIONS TO BE ANSWERED

1. WHY IS IT IMPORTANT TO DETERMINE GRAIN HARVEST LOSSES?
2. HOW MNAY DOLLARS ARE LOST THROUGH HARVEST LOSSES EACH YEAR?
3. HOW IS HARVEST LOSS DETERMINED?
4. HOW LARGE MUST THE LOSS BE BEFORE IT IS WORTH ADJUSTING THE MACHINE?
5. HOW DO YOU DETERMINE THE CAUSES OF MACHINE LOSSES?
6. HOW DO YOU ADJUST THE MACHINE TO MINIMIZE HARVEST LOSSES?

LEARNING ACTIVITIES

1. WHY IS IT IMPORTANT TO DETERMINE GRAIN HARVEST LOSSES?

Raise this question with the class. List their reasons on the board and discuss each reason briefly.

Summarize by pointing out the thing farmers are most concerned about: "To Save Money." You are then ready to lead into question 2.

2. How many dollars are lost through harvest losses each year?

Use transparency #1 to show harvest loss data and transparency #2 to work a sample problem.

Use content summary data for the sample problem.

Sample Problem

Assume you are experiencing a 10% grain harvest loss.

Your soybean yield this year was __________ (30 bu/acre)

Therefore your bu/ac loss was __________ (3)

At $_____/bu ($9) you lost $__________ ($27) per acre

Multiply loss in dollars per acre by total acres grown to get at your personal loss this year.

3. How is harvest loss determined?

Explain how to make the wire frame and calculate total machine loss using transparencies #3-5 and handouts #1 and 2.

4. How large must the loss be before it is worth adjusting the machine?

Give these thumb rules.

Beans:	If losses do not exceed much over 3% do not worry. Use handout #3 (Measuring Soybean Harvest Losses) and transparency #6.
Corn:	If total machine loss is less than two bushels per acre keep on shelling. Use handout #4 (Measuring Corn Harvest Losses) and transparency #7.

Have the class do one or two sample problems to be sure they can calculate losses and apply the thumb rules.

5. How do you determine the causes of machine losses?

Use transparency #8 to show the basic areas of machine losses for soybeans and corn harvesting.

(See content summary.)

6. HOW DO YOU ADJUST THE MACHINE TO MINIMIZE HARVEST LOSSES?

USE TRANSPARENCIES #9-17 TO SHOW PROPER OPERATING TECHNIQUES FOR CORN AND SOYBEANS.

USE TRANSPARENCIES #18A-E TO POINT OUT ADJUSTMENTS AND AVERAGE UNIT SETTINGS FOR THE COMBINE.

DEMONSTRATE IN THE LAB HOW TO MAKE THE ADJUSTMENTS. (IF YOU ARE UNABLE TO DEMONSTRATE THE ADJUSTMENTS, CONSIDER USING A CLASS MEMBER OR A LOCAL REPAIRMAN FOR THIS PART OF THE INSTRUCTION.)

STRIVE TO HAVE FARMERS MAKE THESE ADJUSTMENTS ON THEIR OWN MACHINES. (MIGHT WISH TO ESTABLISH A MINIMUM HARVEST LOSS CONTEST.)

TO SUMMARIZE (NOTE TO TEACHER)

A MACHINE IS NO BETTER THAN ITS OPERATOR; THEREFORE, NO MATTER WHAT MAKE MACHINE WE HAVE, WE MUST STRIVE TO KEEP IT IN PROPER OPERATING CONDITION IN ORDER TO IMPROVE HARVEST EFFICIENCY. READ YOUR OPERATOR'S MANUAL THOROUGHLY, BECOME FAMILIAR WITH THE MACHINE, IMPROVE YOUR DRIVING HABITS, AND TAKE TIME TO CHECK YOUR HARVEST LOSSES OFTEN SO YOU ARE AWARE OF DOLLARS YOU MAY BE LOSING.

A SUMMARY OF THE TECHNIQUES AS OUTLINED IN THIS TEACHING UNIT IS:

A. DETERMINE THE BUSHELS PER ACRE LOST IN HARVEST

B. DETERMINE THE CAUSE OF THESE LOSSES (TOTAL HARVEST LOSS LESS PRE-HARVEST LOSS EQUALS YOUR MACHINE LOSS)

C. DETERMINE WHAT PART OF THE MACHINE IS CAUSING THE LOSS

D. CORRECT THE DEFICIENCIES.

APPLICATION

HAVE STUDENTS MEASURE LOSSES, AND COMPLETE THE ADJUSTMENTS TO MINIMIZE THE LOSSES. PROVIDE EACH WITH A SUMMARY OF THE PROCEDURE INVOLVED IN DETERMINING THE LOSS, AND A CHECKLIST OF CORRECTIVE MEASURES. AT A LATER DATE, MAKE A HOME VISIT TO EACH FARM TO SEE IF RECOMMENDATIONS WERE FOLLOWED, AND WHAT, IF ANY, DECREASES IN HARVEST LOSS OCCURRED.

APPENDIX A

CONTENT SUMMARY

1. CHECKING HARVEST LOSSES
2. CAUSES OF HARVEST LOSSES
3. GATHERING UNIT LOSS
4. CYLINDER AND SEPARATION LOSS
5. CYLINDER LOSS
6. GATHERING UNIT ADJUSTMENTS FOR SOYBEANS
7. GATHERING UNIT ADJUSTMENTS FOR CORN

CORN AND SOYBEAN HARVEST LOSSES

IT IS IMPORTANT TO DETERMINE THE AMOUNT OF COMBINE HARVEST LOSSES. MINIMIZING HARVEST LOSSES WILL INCREASE YIELD PER ACRE, THEREFORE, INCREASE THE PRODUCER'S NET PROFIT. THE AMOUNT OF DOLLARS LOST THROUGH HARVEST LOSSES EACH YEAR DEPENDS ON THE NUMBER OF ACRES HARVESTED AND THE BUSHELS PER ACRE LEFT IN THE FIELD. A STUDY OF SOYBEAN HARVESTING IN OHIO FROM 1956 TO 1960 SHOWED THAT THE TOTAL HARVEST LOSS VARIED FROM 8.8 PERCENT TO 19.3 PERCENT. ASSUMING AN AVERAGE YIELD OF 40 BUSHELS PER ACRE THE RANGE OF HARVEST LOSS IS 3.5 BUSHELS TO 7.7 BUSHELS PER ACRE. THE DESIRABLE LOSS LEVEL IN 40 BUSHELS PER ACRE SOYBEANS IS 1.3 BUSHELS PER ACRE. REDUCTION IN HARVEST LOSS BY TWO BUSHELS PER ACRE WOULD RESULT IN AN INCREASE OF $18.00 PER ACRE GROSS INCOME AT $9.00 PER BUSHEL BEANS. THUS, THE PRODUCER MAY REALIZE A LARGER NET INCOME.

A STUDY OF CORN HARVEST LOSSES DURING A NORMAL HARVEST SEASON REVEALS LOSSES RANGING FROM 2.2 BUSHELS TO 29.4 BUSHELS PER ACRE. INCREASING THE HARVESTING EFFICIENCY BY TEN BUSHELS PER ACRE WOULD RESULT IN $35.00 ADDITIONAL GROSS INCOME ($3.50 PER BUSHEL CORN).

CHECKING HARVEST LOSSES

AN EASY METHOD TO USE IN MAKING KERNEL OR BEAN COUNTS IS TO CONSTRUCT A WIRE OR WOOD FRAME THE SIZE OF THE CHECK AREA. PREPARE A WIRE RECTANGLE USING PLASTIC CLOTHES LINE TIED TO FOUR WIRE PINS. THE RECTANGLE WILL EQUAL THE MACHINE SWATH WIDTH AND THE LENGTH REQUIRED TO ENCLOSE A TEN SQUARE FOOT AREA. (SEE TRANSPARENCY #2.) NOW MAKE THE KERNEL OR BEAN COUNT IN THE TEN SQUARE FOOT AREA. DIVIDE THE TOTAL COUNTY BY FORTY FOR SOYBEANS OR TWENTY FOR CORN TO DETERMINE THE BUSHEL PER ACRE LOSS. TRANSPARENCY #1 HAS THE NUMBER OF UNITS PER 10 SQUARE FEET TO EQUAL A ONE BUSHEL PER ACRE LOSS FOR VARIOUS CROPS.

CAUSES OF HARVEST LOSSES

FIRST CHECK THE TOTAL CROP LOSS AND PRE-HARVEST LOSS. DETERMINE THE TOTAL CROP LOSS BY STOPPING THE COMBINE IN FROM THE EDGES OF THE FIELD AND IN AN AREA REPRESENTATIVE OF THE ENTIRE CROP. PLACE THE RECTANGULAR FRAME ACROSS THE MACHINE SWATH JUST HARVESTED AND COUNT ALL KERNELS OR BEANS FOUND WITHIN THE FRAME. PRE-HARVEST LOSSES MAY BE DETERMINED BY PLACING THE RECTANGULAR FRAME IN THE STANDING BEANS. COUNT ALL THE BEANS LAYING ON THE GROUND NOT ATTACHED TO THE PLANTS. SUBTRACT THE PRE-HARVEST LOSS FROM THE PREVIOUS CALCULATED TOTAL LOSS TO GET MACHINE LOSS. (TOTAL LOSS - PRE-HARVEST LOSS = MACHINE LOSS)

HOWEVER FOR CORN, WE MUST DETERMINE THE EAR LOSS, KERNEL LOSS AND MACHINE LOSS. EAR LOSS MAY BE DETERMINED BY STOPPING THE COMBINE AT LEAST 300 FEET IN FROM THE ENDS OF THE FIELDS WHERE THE CROP IS REPRESENTATIVE OF THE ENTIRE FIELD. (DO NOT CLEAR THE MACHINE.) CHECK THE EAR LOSS BEHIND THE MACHINE BY COUNTING THE NUMBER OF EARS IN EACH ROW COVERED BY THE MACHINE SWATH. COUNT THE NUMBER OF EARS FOUND IN THIS area. (The length of corn rows for this 1/100 acre varies with the row width and number of rows covered by the harvester. (See transparency #2) Measure the rows just harvested the necessary distance to equal 1/100 acre. Gather all missed ears from the rows. Each 3/4 lb. ear or equivalent represents one bushel per acre loss. Then determine pre-harvest ear loss by measuring 1/100 acre of standing corn and gather all ears on the ground free from the stalk. (3/4 pound ear or equivalent represents one bushel per acre.) Total ear loss minus pre-harvest loss equals machine ear loss in bushels per acre.

The corn kernel loss can be determined by stopping the machine in a representative area of the field. (Do not clear the machine) back the machine up at least the length of the machine. Construct a rectangular frame having a width equal to the row width and a length so that the area equals 10 square feet. Place the frame over each of the previously harvested rows of the machine swath. Count all the kernels of corn found in check area. Count all kernels attached to pieces of cob and record separately.

Total (loose and cob) kernel count ÷ 20 = bushels per acre for each row.

Add the bushel losses per frame to determine machine swath loss. Divide the machine swath loss by the number of rows in the machine swath which equals the machine kernel loss in bushels per acre. The total machine loss is determined by adding the machine ear loss and the kernel loss.

Machine loss is excessive when the determined total losses exceed 1.3 bushels per acre for beans and 2.5 bushels for corn. Machine loss for soybeans may be pin pointed by dividing the machine loss into two areas: 1) gathering unit loss and 2) cylinder and separation loss.

Gathering Unit Loss

Stop the combine, quickly disengage the drive clutch of the gathering unit and back the combine up twenty feet. Place the rectangle frame across the machine swath in front of the combine. Count all the beans in the check area and subtract from the pre-harvest loss count and divide by 40 which will give the gathering unit loss in bushels per acre.

When making the above mentioned count you need to indicate the source of the gathering unit loss by the following:

1) Shatter loss (loose beans and pods free of stalk)

2) Stubble loss (beans in pods on stubble)

3) Lodge loss (beans in pods on uncut stalks)

4) Stalk loss (beans in pods on cut stalks)

Divide each of the four counts by 40 to find the specific losses in bushels per acre for each category.

Cylinder and Separation Loss

Machine loss minus gathering unit loss will provide cylinder and separation loss. To further divide these losses by kernel count would necessitate disconnecting the straw spreader. Cylinder loss consists of beans left in the pods after passing through the machine. Separation loss is the amount of loose beans being discharged over the rack and shoe.

Machine losses for corn can be divided into the following categories: 1) cylinder loss, 2) gathering unit loss, and 3) separation loss.

Cylinder Loss

The cylinder loss is the kernels attached to the cob after passing through the machine. (Total ÷ 20 = bushels per acre loss)

Gathering Unit Loss

Gathering unit loss may be determined by placing the rectangular frame in front of the machine free of machine discharge. Place the frame over each row and count the kernels found in each frame area and record.

(Total count ÷ number of rows in swath ÷ 20 = bushels per acre loss)

Separation Loss

Separation loss is the loose kernels that are discharged over the rack and shoe. This loss is determined by taking the total kernel loss minus the cylinder and gathering unit loss.

Gathering Unit Adjustments for Harvesting Soybeans

The following are machine factors that can be corrected by the machine operator. Operate the machine at full throttle to maintain machine operation at recommended levels. The operator should maintain a ground speed of 2.8 - 3.0 miles per hour. You determine the ground speed by counting the number of three feet steps taken in twenty seconds while walking beside the combine. Divide the total number of steps by 10 to get the ground speed in miles per hour. Faster ground speed increases total losses due to overloading the combine.

Recommended reel speed is about 1.25 times faster than ground speed. Reel speed is usually 11 RPM for each one mile per hour ground speed.

Improper reel speed will usually result in increased shatter and loose stalk losses. The relationship of the reel to the cutter bar is shown on transparency #11. The reel can be adjusted up and down to accommodate different height crops. Also, adjust the reel forward or backward on the support arms to permit the proper laying of the crop on the grain platform. A properly adjusted reel should enter the crop deep enough to gain control of the crop. The forward position of the reel is correct when the reel bat gently nudges the grain back over the cutter bar just as the grain straw is cut by the knife.

The producer should make every effort to harvest when beans contain 18-19 percent moisture if he is going to dry them or 15 percent if not drying and complete harvesting as quickly as possible. Operate the header as close to the ground as possible.

Corn Gathering Unit Adjustments

Operate the gathering head so that the snouts are just touching the ground and the gathering chains are about two inches above ground level. Use the same ground speed recommended to use with soybeans and concentrate on "accurate" driving, matching rows and making sure the header is down and aligned with rows. Begin harvesting when moisture content is 22 percent if corn is to be marketed. Attempt to complete the harvest before wet, cold weather and moisture content decreases below 18 percent.

Adjust the stripper plates open over the snapping roles as wide as possible without permitting ears to pass through. (Adjust all rows the same.) The blade snapping roles should be adjusted to pull the stalk through the stripper plate at a point about 2/3 of the way up on the stripper plate. Adjust the gathering chain flights about 1/4" beyond the forward lip of the stripper plate.

Cylinder Speed

Cylinder speed should be adjusted only when running. The cylinder speed range is 150 to 1500 RPM. A tachometer is needed to determine the cylinder speed. The average settings for corn is 400-900 RPM and for soybeans is 450-850 RPM.

Concave Spacing

Average concave spacings for corn is 1 - 1 1/2 inches and soybeans 3/8 - 1 inch setting.

The operator should use the manufacturer's recommended cylinder and concave settings and make only small adjustments in speed or clearance to obtain the desired cylinder loss of 0.2 to 0.3 bushel per acre.

CHAFFER AND SIEVE CONTROL

THE AVERAGE SIEVE SETTINGS FOR CORN IS 1/2 - 5/8 INCH AND SOYBEANS 3/8 - 1/2 INCH. CHAFFER SETTINGS AVERAGE FOR CORN IS 7/16 - 5/8 INCH AND SOYBEANS IS 1/2 - 3/4 INCH.

FAN SPEED CONTROL

FAN SPEED SHOULD BE ADJUSTED ONLY WHEN OPERATING. THE OPERATOR SHOULD AVOID SLOW FAN SPEEDS BUT MUST BE CAUTIOUS NOT TO BLOW OUT GRAIN. THE FAN SPEED SHOULD BE ADJUSTED ACCORDING TO RECOMMENDATIONS OF THE MANUFACTURER.

APPENDIX B

INSTRUCTIONAL MATERIALS

HANDOUTS

H-1: APPROXIMATE NUMBER OF KERNELS PER TEN SQUARE FEET TO EQUAL ONE BUSHEL LOSS PER ACRE

H-2: ROW LENGTH IN FEET PER 1/100 ACRE

H-3: A GUIDE FOR MEASURING SOYBEAN HARVEST LOSSES

H-4: A GUIDE FOR MEASURING CORN HARVEST LOSSES

TRANSPARENCIES

T-1: OHIO SOYBEAN HARVEST LOSS FROM 1956 - 1960

T-2: COMBINE HARVESTING

T-3: PROCEDURE FOR CONSTRUCTING RECTANGULAR FRAME TO CHECK HARVEST LOSS

T-4: APPROXIMATE NUMBER OF KERNELS PER TEN SQUARE FEET TO EQUAL ONE BUSHEL LOSS PER ACRE

T-5: ROW LENGTH IN FEET PER 1/100 ACRE

T-6: SOYBEAN LOSS DATA

T-7: COMPARE YOUR LOSSES TO THOSE OF AN EXPERT

T-8: MACHINE UNITS CONTRIBUTING TO HARVEST LOSSES

T-9: MACHINE ADJUSTMENT TO MINIMIZE HARVESTING LOSS IN SOYBEANS

T-10: CORRECT REEL ADJUSTMENT

T-11: INCORRECT REEL ADJUSTMENT

T-12: CORRECT REEL POSITION

T-13: REEL SPEED TOO FAST

T-14: Machine Adjustments to Minimize Harvest Loss With Corn

T-15: Gathering Chain

T-16: Snapping Rolls

T-17: Adjust the Gathering Snouts

T-18A: Cylinder Speed Control

T-18B: Concave Spacing Control

T-18C: Sieve Settings

T-18D: Chaffer Settings

T-18E: Fan Speed Control

APPROXIMATE NUMBER OF KERNELS PER TEN SQUARE FEET TO EQUAL ONE BUSHEL LOSS PER ACRE

CROP	APPROX. NO. OF KERNELS
WHEAT	200
OATS	100
SOYBEANS	40
BARLEY	140
RYE	220
CORN	20

RECTANGULAR DIMENSIONS FOR 10 SQUARE FOOT PLOT

MACHINE SWATH	DISTANCE TO ENCLOSE 10 SQ. FT.
8′	15″
9′	13.5″
10′	12″
12′	10″
13′	9.25″
14′	8.6″
15′	8″
15.5′	7.75″
16′	7.5″
18′	6.75″
20′	6″
22′	5.5″
24′	5″

ROW LENGTH IN FEET PER 1/100 ACRE

DISTANCE - 1/100 A. FOR

Row Width Inches	One Row	Two Rows	Three Rows	Four Rows	Six Rows	Eight Rows
20	262	131	87.3	65.5	43.6	32.7
28	187	93.5	61.3	46.7	31.1	
30	174	87	58	43.6	29	
36	145	72.5	48.3	36.2		
38	138	69	46	34.5		
40	131	65.5	43.6	32.7		
42	124	62	41.3	31		

ROW LENGTH FOR 10 SQ. FT. FRAME

Row Width Inches	Row Length Inches
20	*
28	51.5
30	48
36	40
38	38
40	36
42	34

*USE SAME FRAME AS FOR 40 INCH ROWS, BUT PLACE FRAME OVER TWO ROWS AT A TIME.

FIRST, determine ear loss

1. Stop the corn combine at least 300 feet in from the ends of the fields and where the corn crop is representative of the entire field. Do not clear the combine. Disconnect straw spreader.

Determine the ear loss to the rear of the machine and on all the rows covered by that machine swath. See sketch below. This ear loss is gathered from 1/100 acre. The length of corn rows for this 1/100 acre varies with the row width and the number of rows covered by the machine swath. See Table I for this information.

TABLE I ROW LENGTH IN FEET PER 1/100 ACRE

	Distance 1/100A. For					
Row Width Inches	One Row	Two Rows	Three Rows	Four Rows	Six Rows	Eight Rows
20	262	131	87.3	65.5	43.6	32.7
28	187	93.5	61.3	46.7	31.1	
30	174	87	58	43.6	29	
36	145	72.5	48.3	36.2		
38	138	69	46	34.5		
40	131	65.5	43.6	32.7		
42	124	62	41.3	31		

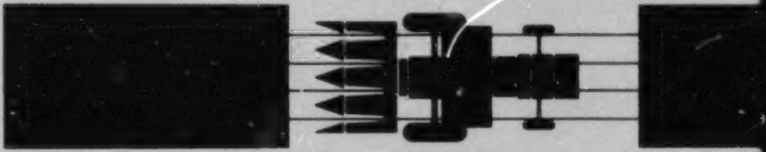
2. Make a mark on one of the rows just harvested and pace off the necessary distance for your 1/100 acre. Again make a mark on the ground. Then proceed [illegible] gather all missed ears from all rows of your machine swath. Each ¾ pound ear, or equivalent in smaller ears, represents one bushel per acre loss. Three ½ pound ears represent 2 bushels per acre. ______________________

Ent

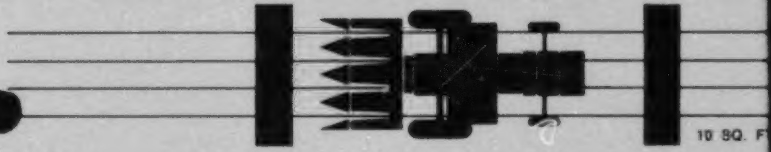
3. If you found an ear loss at the rear of the machiine, then you should determine how much of this loss was pre-harvest (ears already on the ground before the machine entered the field). To determine pre-harvest loss, go to standing corn in front of machine and again pace off the distance for 1/100 acre for your machine swath. Gather all ears on the ground from this area and evaluate. ______________________

Enter pre-

4. Determine the machine ear loss by subtracting the pre-harvest loss (part 3.) from the total ear loss (part 2.). ______________________



NEXT, determine corn kernel loss



1. *Loose kernel loss and cylinder loss* are measured at the rear of the machine in rectangular plots enclosing an area of 10 square feet. See Table 2 for row width and length, then construct a rectangular frame of #9 wire or narrow wooden strips for your particular row width. Frame can be carried on machine for ready use.

An average of 2 kernels per square foot equals one bushel per acre so every 20 kernels per frame equals one bushel per acre.

TABLE 2 LENGTH FOR 10 SQ. FT. FRAME

Row Width Inches	Row Length Inches
20	*
28	51.5
30	48
36	40
38	38
40	36

*Use same frame as for 40 inch rows, but place frame over 2 rows at a time.

2. *Measure loose kernel loss and cylinder loss* at the rear of the machine using the rectangular frame centered progressively over each row of the machine swath as shown at A in sketch above. Remove stalks and leaves from within the frame area. Count the *loose kernels* found in this area and record in loss Table "A". Also, in the same frame area, count the kernels of corn still attached to the cobs. This is the *cylinder loss*. Record this count in loss Table "B". Now, 20 kernels per frame equals 1 bushel per acre so divide each of the kernel counts by 20. This gives the per row loss in bushels per acre. The average loose kernel loss and cylinder loss is then determined by adding up the per row losses and dividing by the number of rows.

If loose kernel loss is between 0.4 and 1.0 bushels per acre there is no real need to determine snapping roll loss. But, if it is greater, then it is necessary to measure the snapping roll loss in order to pinpoint the sources of loose kernel loss.

3. To dete
bine about 2
progressively
Count the lo
record these

4. The loo
snapping roll
the snapping

e ear loss

t in from
is repre-
combin

machine
wath. See
om 1/100
cre varies
overed by
mation.

100 ACRE

ows	Eight Rows
	32.7

2. Make a mark on one of the rows just harvested and pace off the necessary distance for your 1/100 acre. Again make a mark on the ground. Then proceed [illegible] gather all missed ears from all rows of your machine swath. Each ¾ pound ear, or equivalent in smaller ears, represents one bushel per acre loss. Three ½ pound ears represent 2 bushels per acre.

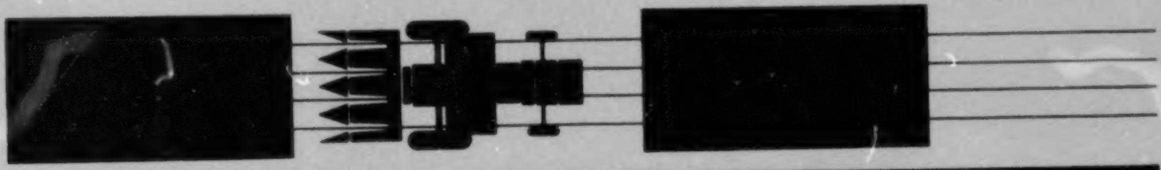
Enter total ear loss here = Bu./Acre

3. If you found an ear loss at the rear of the machine, then you should determine how much of this loss was pre-harvest (ears already on the ground before the machine entered the field). To determine pre-harvest loss, go to standing corn in front of machine and again pace off the distance for 1/100 acre for your machine swath. Gather all ears on the ground from this area and evaluate.

Enter pre-harvest ear loss here = Bu./Acre

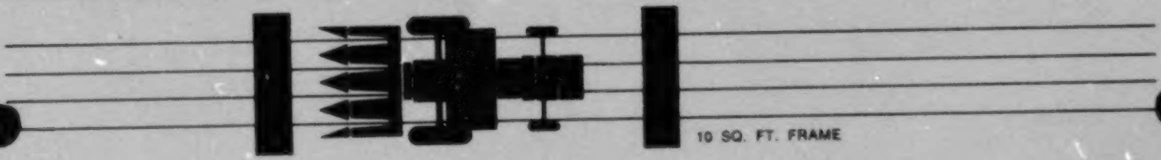
4. Determine the machine ear loss by subtracting the pre-harvest loss (part 3.) from the total ear loss (part 2.).

Machine ear loss = Bu./Acre



---

e



measured
ots enclos-
row width
ame of #9
ticular row
ready use.
equals one
ame equals

w Length Inches
*
51.5
48
40
38
36

over 2 rows

2. *Measure loose kernel loss and cylinder loss* at the rear of the machine using the rectangular frame centered progressively over each row of the machine swath as shown at A in sketch above. Remove stalks and leaves from within the frame area. Count the *loose kernels* found in this area and record in loss Table "A". Also, in the same frame area, count the kernels of corn still attached to the cobs. This is the *cylinder loss*. Record this count in loss Table "B". Now, 20 kernels per frame equals 1 bushel per acre so divide each of the kernel counts by 20. This gives the per row loss in bushels per acre. The average loose kernel loss and cylinder loss is then determined by adding up the per row losses and dividing by the number of rows.

If loose kernel loss is between 0.4 and 1.0 bushels per acre there is no real need to determine snapping roll loss. But, if it is greater, then it is necessary to measure the snapping roll loss in order to pinpoint the sources of loose kernel loss.

3. To determine snapping roll loss, back up the combine about 20 feet. Then, place the rectangular frame progressively over the corn rows as shown in B above. Count the loose kernels found within the frame and record these counts in loss table "C".

4. The loose kernel loss can now be divided into snapping roll loss and separation loss by subtracting the snapping roll loss from the loose kernel loss.

LOOSE KERNEL LOSS TABLE "A"

Row	Loose Kernels Per Frame	Kernels = to 1 Bu./A.	Loss Per Row in Bu./A.
1		20	
2		20	
3		20	
4		20	
5		20	
6		20	
7		20	
8		20	
			Total

Average Loose Kernel Loss is the total for all rows = ______ # Rows

divided by the number of rows = ______ Bu./Acre

CYLINDER LOSS TABLE "B"

Row	Kernels on Cob Per Frame	Kernels = to 1 Bu./A.	Loss Per Row in Bu./A.
1		20	
2		20	
3		20	
4		20	
5		20	
6		20	
7		20	
8		20	
			Total

Average Cylinder Loss is the total for all rows = ______ # Rows

divided by the number of rows = ______ Bu./Acre

SNAPPING ROLL LOSS TABLE "C"

Row	Loose Kernels Per Frame	Kernels = to 1 Bu./A.	Loss Per Row in Bu./A.
1		20	
2		20	
3		20	
4		20	
5		20	
6		20	
7		20	
8		20	
			Total

Average Snapping Roll Loss is the total for all rows = ______ # Rows

losses divided by the number of rows = ______ Bu./Acre

COMPARE YOUR LOSSES TO THOSE OF AN EXPERT!

Loss Source	Your Losses Bu./Acre	Experts' Losses Bu./Acre
Machine ear loss		0 to 1
Loose kernel loss		0.4 to 1
(Snapping roll)		0.2 to 0.5
(Separation)		0.2 to 0.5
Cylinder loss		0.2 to 0.5
TOTAL		0.6 to 2.5*

*Corn standing 90% or better and at a moisture of 20 to 26%.

TIPS FOR KEEPING LOSSES LOW

Remember that gathering head losses usually constitute the greatest source of loss for the combine as well as the picker.

1. Run combine engine at proper "governed" speed and pickers at proper "P.T.O." speed.

2. Use a ground speed of 2.8 to 3.0 miles per hour. To determine ground speed, count the number of 3 ft. steps taken in 20 seconds while walking beside the machine. Divide this number by 10 to get the ground speed in miles per hour.

3. Close stripper plates or snapping bars only enough to prevent ears from passing through.

4. Chain flights over stripper plates should extend beyond edge of plates of ⅛ inch.

5. Ears should be snapped near upper ⅓ of snapping roll.

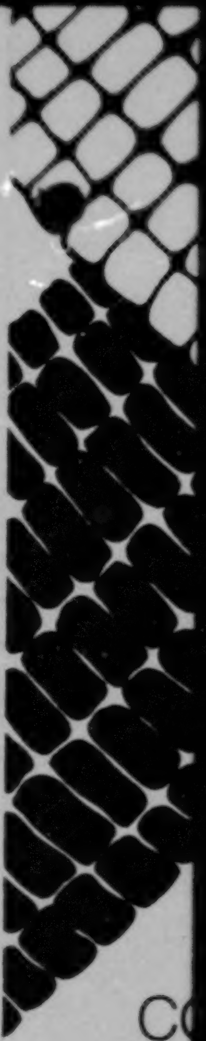
6. Drive accurately on matched rows spaced to your harvesting machine.

7. Gathering snouts should float on the ground and gathering chains should be just above the ground.

8. Measure losses and make corrective machine adjustments whenever crop conditions change.

Prepared by Delbert M. Byg, Extension Agricultural Engineer, The Ohio State University. Printed courtesy Allis-Chalmers.

AED-106 LITHO IN U.S.A.



C

Every farme
vesting his
an expert is
ing losses
those of the
of loss is kn
in machine
keep losses
ured in abou
of the mach

oss Per
Row in
Bu./A.

Total

____ # Rows

____ Bu./Acre

oss Per
Row in
Bu./A.

Total

____ # Rows

____ Bu./Acre

the greatest

nd pickers at

To determine
n 20 seconds
by 10 to get

h to prevent

yond edge of

CYLINDER LOSS TABLE "B"

Row	Kernels on Cob Per Frame	Kernels = to 1 Bu./A.	Loss Per Row in Bu./A.
1		20	
2		20	
3		20	
4		20	
5		20	
6		20	
7		20	
8		20	
			Total

Average Cylinder Loss is the total for all rows = __________ # Rows

divided by the number of rows = __________ Bu./Acre

COMPARE YOUR LOSSES TO THOSE OF AN EXPERT!

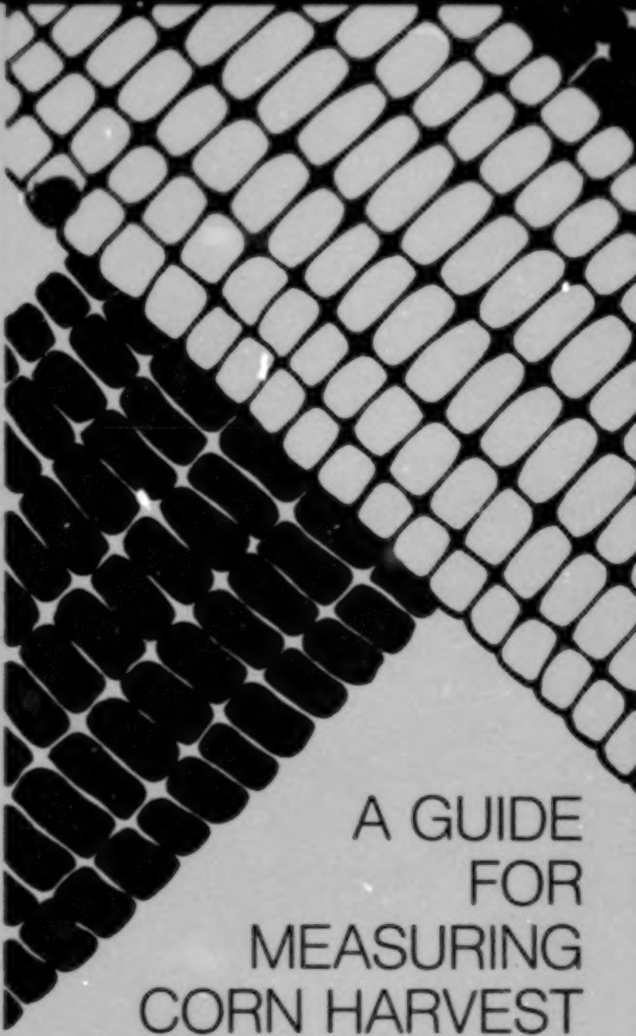
Loss Source	Your Losses Bu./Acre	Experts' Losses Bu./Acre
Machine ear loss		0 to 1
Loose kernel loss		0.4 to 1
(Snapping roll)		0.2 to 0.5
(Separation)		0.2 to 0.5
Cylinder loss		0.2 to 0.5
TOTAL		0.8 to 2.5*

*Corn standing 90% or better and at a moisture of 20 to 28%.

5. Ears should be snapped near upper ⅓ of snapping roll.
6. Drive accurately on matched rows spaced to your harvesting machine.
7. Gathering snouts should float on the ground and gathering chains should be just above the ground.
8. Measure losses and make corrective machine adjustments whenever crop conditions change.

Prepared by Delbert M. Byg, Extension Agricultural Engineer, The Ohio State University. Printed courtesy Allis-Chalmers.

AED-108 LITHO IN U.S.A.



A GUIDE FOR MEASURING CORN HARVEST LOSSES

Every farmer wants to do an "expert" job of harvesting his corn crop but the only sure way to be an expert is to have a fast, easy method for checking losses and then comparing your losses to those of the experts. Once the source and extent of loss is known, it is usually easy to make changes in machine adjustment and operating practices to keep losses to a minimum. Losses can be measured in about 10 minutes depending upon the size of the machine.

LOSS DATA TABLE

Source of Loss	Column A Beans Found in 10 Sq. Ft. Area	Number of Beans = To 1 Bu./Acre	Column B Your Bean Loss in Bu./Acre	Column C Desirable Loss Level in 40 Bu./Acre Yield
1. Total Crop Loss		40		1.3
2. Pre-Harvest Loss		40		0.1
3. Machine Loss		40		1.2
4. Gathering Unit Loss. Totals of:		40		1.1
a. Shatter		40		0.4
b. Loose Stalk		40		0.2
c. Lodged Stalk		40		0.2
d. Stubble		40		0.3
5. Cylinder and Separation Loss	▨	▨		0.1

TIPS FOR KEEPING COMBINE LOSSES LOW

Remember that more than 80 percent of the machine loss usually occurs at the gathering unit. The following suggestion will help keep these losses to a minimum.

1. Make sure that knife sections, guards, wear plates and hold-down clips are in good condition and properly adjusted.
2. Keep seedbed level! Do not earth-up soil around beans when cultivating.
3. Operate the cutterbar as close to the ground as possible at all times.
4. Use a ground speed of 2.8 to 3.0 miles per hour. To determine ground speed, count the number of 3 ft. steps taken in 20 seconds while walking beside the combine. Divide this number by 10 to get the ground speed in miles per hour.
5. Use a reel speed about 25 percent faster than ground speed or for 42 inch diameter reels, use a reel speed of 11 r.p.m. for each 1 mile per hour ground speed.
6. Reel axle should be 6 to 12 inches ahead of cutterbar. Reel bats should leave beans just as they are cut. Reel depth should be just enough to control the beans.
7. A 6 bat reel will give more uniform feeding.

EA-9087 Prepared by Delbert H. Byg, Extension Agricultural Engineer, The Ohio State University.

ME

A sure
use a
machin
extent
make
and op
to a mi
in 10 m

LOSS DATA TABLE

A d in res	Number of Beans = To 1 Bu./Acre	Column B Your Bean Loss in Bu./Acre	Column C Desirable Loss Level in 40 Bu./Acre Yield
	40		1.3
	40		0.1
	40		1.2
	40		1.1
	40		0.4
	40		0.2
	40		0.2
	40		0.3
▨	▨		0.1

R KEEPING COMBINE LOSSES LOW

e machine loss usually occurs at the gathering unit. The following sugges-
num.

s, wear plates and hold-down clips are in good condition and properly ad-

soil around beans when cultivating.

ground as possible at all times.

es per hour. To determine ground speed, count the number of 3 ft. steps
side the combine. Divide this number by 10 to get the ground speed in miles

ter than ground speed or for 42 inch diameter reels, use a reel speed of 11
d speed.

head of cutterbar. Reel bats should leave beans just as they are cut. Reel
rol the beans.

eding.

---

on Agricultural Engineer, The Ohio State University.

A GUIDE FOR MEASURING SOYBEAN HARVEST LOSSES

A sure way to up harvested yield is to use a fast, easy method for measuring machine losses. Once the source and extent of loss is known, it is easy to make changes in machine adjustment and operating practices to keep losses to a minimum. Losses can be measured in 10 minutes or less.

I. An average of 4 beans per square foot equals about 1 bushel per acre loss.

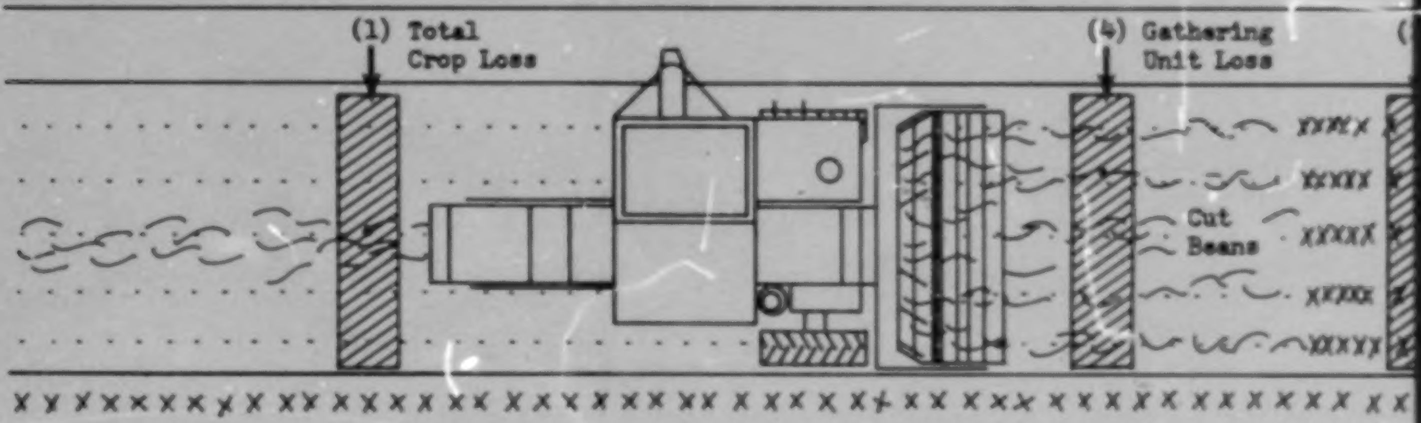
II. Construct a rectangular frame that encloses an area of 10 sq. ft. and is equal in width to the combine header. **See Table 1.** A plastic clothesline taped to 4 wire pins made of #9 wire makes a handy measuring frame.

III. Place the rectangular frame across the machine swath as shown in sketch below and make loss counts for:

Table 1

Dimensions For Rectan

Header Width (Ft.)
8'
10'
12'
13'
14'



Procedure

1. Stop combine at least 300 feet in from ends of field and where crop is typical of [illegible] field. Back up combine about 15 feet. Place rectangular frame across swath harvested at rear of combine. Count all beans in frame and enter this count in loss data table column 1-A. Divide this number by 40 and enter the loss in bushels per acre in column 1-B. If loss is near 3% of yield, keep right on harvesting. If loss is greater, then proceed to pinpoint the sources of loss.

2. Determine pre-harvest loss by placing rectangular frame in standing beans in front of combine. Count loose beans on ground and beans in pods laying loose on ground. Enter this number in column 2-A and then divide by 40 to get loss in bushels per acre. Enter this loss in column 2-B.

3. Machine loss is determined by subtracting the pre-harvest loss from the total crop loss. If machine loss is near 3 percent of yield or less, keep right on harvesting. If more, then proceed to check gathering unit losses.

4. Gathering unit losses are determined by placing the rectangular frame in the space between the parked combine and the standing beans. Then proceed to make bean counts as follows:

(a) Shatter loss—count all loss beans on grou
Enter this number in column 4 a—A and
4 a—B.

(b) Loose stalk loss—count all beans in pod
cut but not gathered into machine. Enter t
bushel per acre loss in column 4 b—B.

(c) Lodged stalk loss—count all beans in pod
lodged and are still attached to the grou
A and enter bushel per acre loss in colu

(d) Stubble loss—count all beans in pods still
in column 4 d—A and enter bushel per

Total gathering unit loss is now obtained by ad
stubble, loose stalk and lodged stalk losses. E

5. Cylinder and separation loss is now determined
from the machine loss. Enter this difference in

Note: Now compare your harvest loss levels to th
machine adjustments and operating practic
Repeating these loss checks in different
their accuracy.

quals about 1 bushel per acre loss.

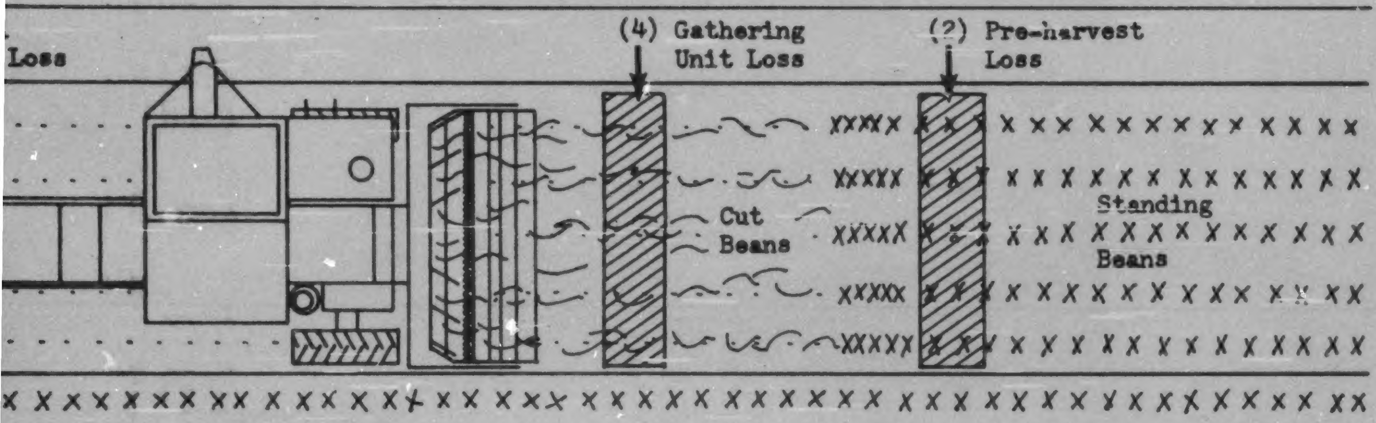
ss an area of 10 sq. ft. and is equal in width
lastic clothesline taped to 4 wire pins made
ame.

achine swath as shown in sketch below and

Table 1

Dimensions For Rectangular Frame

Header Width (Ft.)	Frame Length (In.)
8′	15″
10′	12″
12′	10″
13′	9.25″
14′	8.6″



ds of field and where crop is typical of entire
ce rectangular frame across swath harvested
rame and enter this count in loss data table
enter the loss in bushels per acre in column
on harvesting. If loss is greater, then proceed

ctangular frame in standing beans in front of
and beans in pods laying loose on ground.
divide by 40 to get loss in bushels per acre.

the pre-harvest loss from the total crop loss.
d or less, keep right on harvesting. If more,
es.

placing the rectangular frame in the space
ding beans. Then proceed to make bean counts

(a) Shatter loss—count all loss beans on ground and beans in loose pods on ground. Enter this number in column 4 a—A and enter bushels per acre loss in column 4 a—B.

(b) Loose stalk loss—count all beans in pods attached to soybean stalks that were cut but not gathered into machine. Enter this number in column 4 b—A and enter bushel per acre loss in column 4 b—B.

(c) Lodged stalk loss—count all beans in pods attached to soybean stalks that were lodged and are still attached to the ground. Enter this number in column 4 c—A and enter bushel per acre loss in column 4 c—B.

(d) Stubble loss—count all beans in pods still attached to stubble. Enter this number in column 4 d—A and enter bushel per acre loss in column 4 d—B.

Total gathering unit loss is now obtained by adding the losses in column B for shatter, stubble, loose stalk and lodged stalk losses. Enter this number in column 4-B.

5. Cylinder and separation loss is now determined by subtracting the gathering unit loss from the machine loss. Enter this difference in column 5-B.

Note: Now compare your harvest loss levels to those in column C. Then concentrate on machine adjustments and operating practices that will give the least total loss. Repeating these loss checks in different parts of the field will greatly increase their accuracy.

APPROXIMATE NUMBER OF KERNELS PER TEN SQUARE FEET TO EQUAL ONE BUSHEL LOSS PER ACRE

CROP	APPROX. NO. OF KERNELS
WHEAT	200
OATS	100
SOYBEANS	40
BARLEY	140
RYE	220
CORN	20

RECTANGULAR DIMENSIONS FOR 10 SQUARE FOOT PLOT

MACHINE SWATH	DISTANCE TO ENCLOSE 10 SQ. FT.
8′	15″
9′	13.5″
10′	12″
12′	10″
13′	9.25″
14′	8.6″
15′	8″
15.5′	7.75″
16′	7.5″
18′	6.75″
20′	6″
22′	5.5″
24′	5″

ROW LENGTH IN FEET PER 1/100 ACRE

Row Width Inches	Distance - 1/100 A. for One Row	Two Rows	Three Rows	Four Rows	Six Rows	Eight Rows
20	262	131	87.3	65.5	43.6	32.7
28	187	93.5	61.3	46.7	31.1	
30	174	87	58	43.6	29	
36	145	72.5	48.3	36.2		
38	138	69	46	34.5		
40	131	65.5	43.6	32.7		
42	124	62	41.3	31		

ROW LENGTH FOR 10 SQ. FT. FRAME

Row Width Inches	Row Length Inches
20	*
28	51.5
30	48
36	40
38	38
40	36
42	34

*Use same frame as for 40 inch rows, but place frame over two rows at a time.

H 2

OHIO SOYBEAN HARVEST LOSS FROM 1956 - 1960

Average per acre yield	40 bushels
Harvest losses 8.8% - 19.3%	3.5 - 7.7 bushels
Average Harvest loss	5.6 bushels

T 1

COMBINE HARVESTING

COMBINE "OPERATOR'S" REALISTIC VIEW

100 BUSHELS PER ACRE
X $____ PER BUSHEL
$ GROSS INCOME
- ______ GROSS EXPENSES
$ POTENTIAL PROFIT
- HARVEST LOSSES
______
$ NET PROFIT

COMBINE LOSSES EQUAL __ PER CENT OF POTENTIAL PROFIT.

BY ADJUSTING THE COMBINE, THE OPERATOR CAN REALIZE AN ADDITIONAL $ PROFIT PER ACRE.

NEW TOTAL NET PROFIT = $___ PER ACRE

PROCEDURE TO FOLLOW IN CONSTRUCTING A RECTANGULAR FRAME TO USE IN CHECKING HARVEST LOSSES

1. TAKE A PLASTIC CLOTHES LINE AND TIE IT TO FOUR STAKES SO THAT THE RECTANGLE ENCLOSED BY THE STRING IS EQUAL TO THE MACHINE SWATH WIDTH AND THE LENGTH NECESSARY TO ENCLOSE AN AREA OF TEN SQUARE FEET. (SEE T 2.)

2. COUNT THE NUMBER OF KERNELS OR BEANS IN THE 10 SQUARE FOOT AREA.

3. DIVIDE THE NUMBER OF KERNELS OR BEANS FOUND BY THE NUMBER OF KERNELS OR BEANS PER 10 SQUARE FEET TO EQUAL ONE BUSHEL PER ACRE.

   NOTE: 40 BEANS PER 10 SQUARE FEET EQUALS ONE BUSHEL PER ACRE SOYBEAN LOSS.
   20 KERNELS PER 10 SQUARE FEET EQUALS ONE BUSHEL PER ACRE CORN LOSS.

T 3

APPROXIMATE NUMBER OF KERNELS PER TEN SQUARE FEET TO EQUAL ONE BUSHEL LOSS PER ACRE

CROP	APPROX. NO. OF KERNELS
WHEAT	200
OATS	100
SOYBEANS	40
BARLEY	140
RYE	220
CORN	20

RECTANGULAR DIMENSIONS FOR 10 SQUARE FOOT PLOT

MACHINE SWATH	DISTANCE TO ENCLOSE 10 SQ. FT.
8′	15″
9′	13.5″
10′	12″
12′	10″
13′	9.25″
14′	8.6″
15′	8″
15.5′	7.75″
16′	7.5″
18′	6.75″
20′	6″
22′	5.5″
24′	5″

ROW LENGTH IN FEET PER 1/100 ACRE

	Distance - 1/100 A. for					
Row Width Inches	One Row	Two Rows	Three Rows	Four Rows	Six Rows	Eight Rows
20	262	131	87.3	65.5	43.6	32.7
28	187	93.5	61.3	46.7	31.1	
30	174	87	58	43.6	29	
36	145	72.5	48.3	36.2		
38	138	69	46	34.5		
40	131	65.5	43.6	32.7		
42	124	62	41.3	31		

ROW LENGTH FOR 10 SQ. FT. FRAME

Row Width Inches	Row Length Inches
20	*
28	51.5
30	48
36	40
38	38
40	36
42	34

*Use same frame as for 40 inch rows, but place frame over two rows at a time.

SOYBEAN LOSS DATA

Source of Loss	Beans Found in 10 sq. ft. area	# of Beans = 1 bu/ac.	Bean Loss in Bu/ac.	Desirable Loss Level in 40 bu/ac. yield
Total Crop Loss		40		1.3
Pre-Harvest Loss		40		0.1
Machine Loss		40		1.2
Gathering Unit Loss Totals		40		1.1
A. Shatter		40		0.4
B. Loose Stalk		40		0.2
C. Lodged Stalk		40		0.2
D. Stubble		40		0.3
Cylinder and Separation Loss				0.1

CORN LOSS DATA

COMPARE YOUR LOSSES TO THOSE OF AN EXPERT

Source	Your Losses Bu/Ac	Experts Losses Bu/Ac
Machine Ear Loss		0 - 1
Loose Kernel Loss		0.4 - 1
Snapping Roll		0.2 - 0.5
Separation		0.2 - 0.5
Cylinder Loss		0.2 - 0.5
Total		0.6 - 2.5

T 7

MACHINE UNITS CONTRIBUTING TO HARVEST LOSSES

CORN AND SOYBEANS

1. GATHERING UNIT
2. CYLINDER UNIT
3. SEPARATION

OPERATING PRACTICES

1. OPERATING THE GATHERING HEAD SO THE GATHERING SNOUTS ARE FLOATING ON THE GROUND AND THE GATHERING CHAINS JUST ABOVE THE GROUND.
2. CONCENTRATE ON "ACCURATE" DRIVING, ON MATCHING ROWS AND MAKE SURE HEADER IS DOWN AND ALIGNED PERFECTLY ON NEW ROWS AFTER TURNING AT END OF FIELD.
3. USE A GROUND SPEED OF 2.8 TO 3 MILES PER HOUR.
4. START HARVESTING WHEN THE GRAIN IS ABOUT 26% MOISTURE IF CORN IS TO BE MARKETED. THEN STRIVE TO COMPLETE THE HARVEST BEFORE THE WEATHER TURNS WET, COLD AND ICY OR SNOWY, AND ALSO BEFORE THE GRAIN MOISTURE DROPS BELOW 18%.

MACHINE ADJUSTMENT TO MINIMIZE HARVESTING LOSS WITH SOYBEANS

FOR BEANS

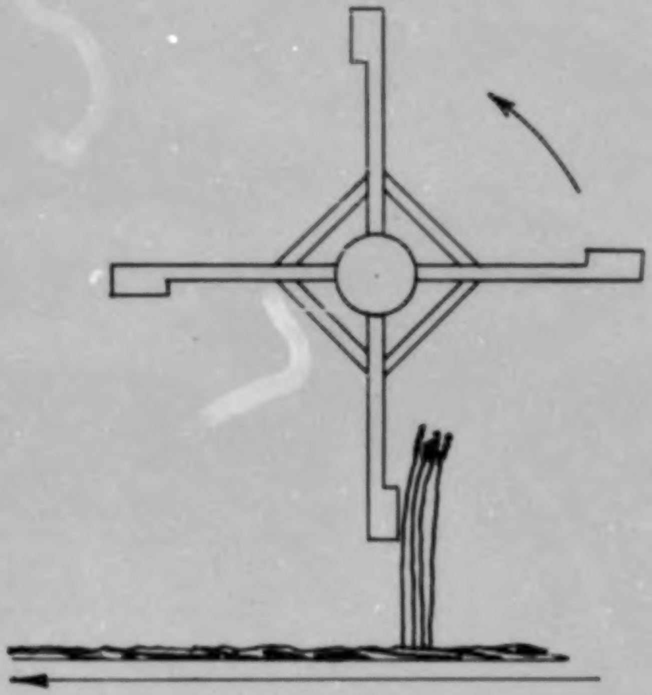
A) FACTORS THAT CAN BE CORRECTED BY OPERATOR:

1. ADJUST REEL HEIGHT - SHOULD BE 3 TO 8 INCHES ABOVE CUTTER BAR
2. ADJUST REEL PITCH (PICK-UP TYPE REEL) - SHOULD BE PITCHED SLIGHTLY REARWARD TO PICK UP LODGED BEANS
3. ADJUST REEL POSITION, IF POSSIBLE - IF TOO FAR FORWARD, GRAIN WILL NOT BE MOVED ONTO PLATFORM; IF TOO FAR BACKWARD, GRAIN WILL WRAP ON REEL BATS AND RIDE OVER THE REEL
4. ADJUST REEL SPEED (RECOMMENDED SPEED - 1.25 TIMES FASTER THAN GROUND SPEED)
5. CHECK KNIFE SHARPNESS AND CYCLE REGISTER
6. GROUND SPEED - ALWAYS RUN AT FULL THROTTLE TO KEEP MACHINE SPEED UP TO RECOMMENDED LEVELS; DRIVING TOO FAST INCREASES TOTAL LOSSES DUE TO OVERLOADING THE COMBINE
7. EVERY EFFORT SHOULD BE MADE TO START HARVESTING BEANS WHEN THEY ARE AT 15% MOISTURE, AND THEN COMPLETE THE HARVEST AS QUICKLY AS POSSIBLE.

B) EXTRA OPTIONAL EQUIPMENT THAT CAN BE PURCHASED FOR A COMBINE THAT WILL IMPROVE HARVEST EFFICIENCY:

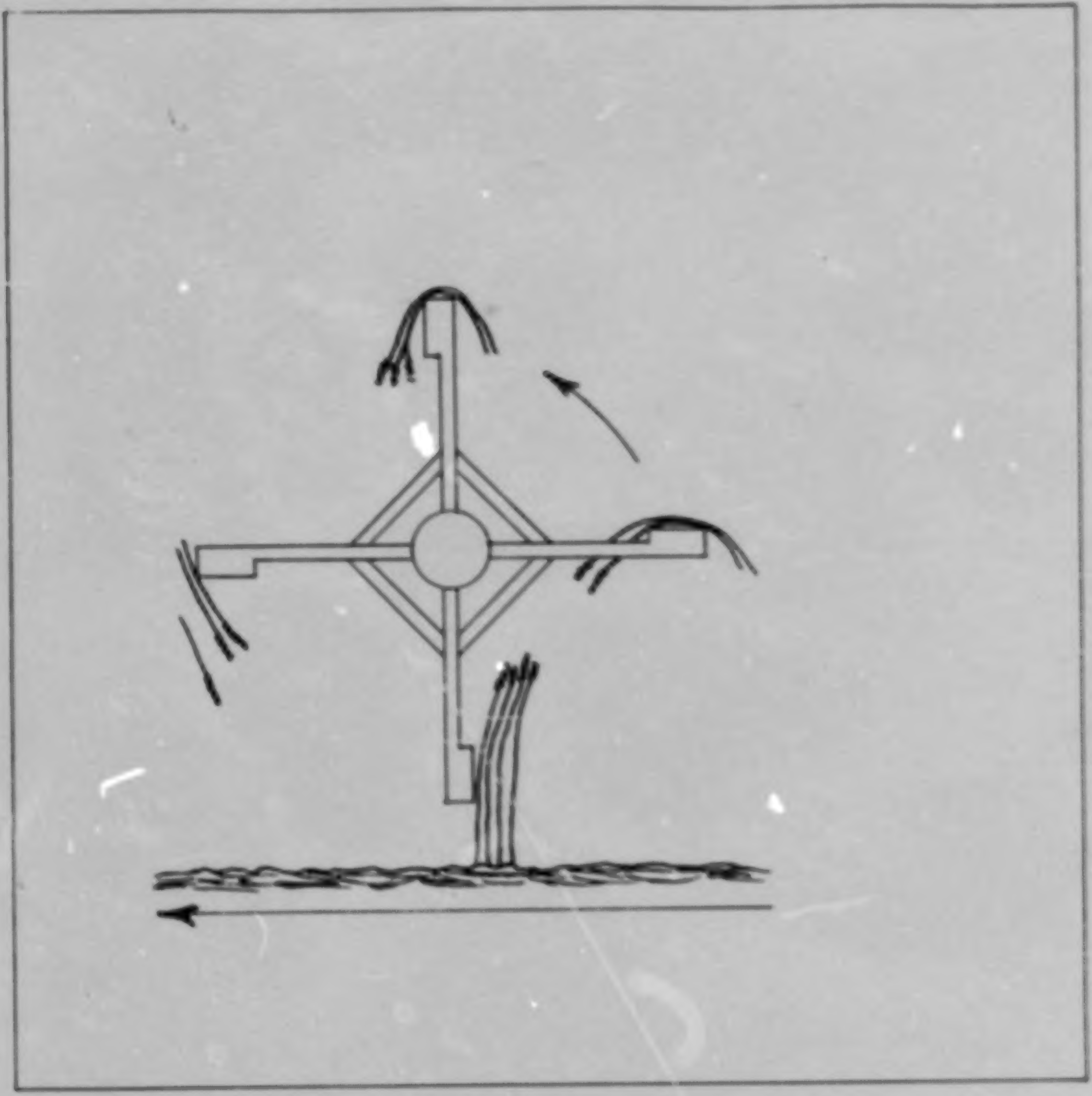
1. FLOATING CUTTER BAR
2. FLOATING HEADER CONTROLS (HYDRAULIC-OR-MECHANICAL SPRING FLOAT)
3. VARIABLE SPEED REEL
4. HYDRAULIC-CONTROLLED REEL HEIGHT

T 9



CORRECT REEL ADJUSTMENT

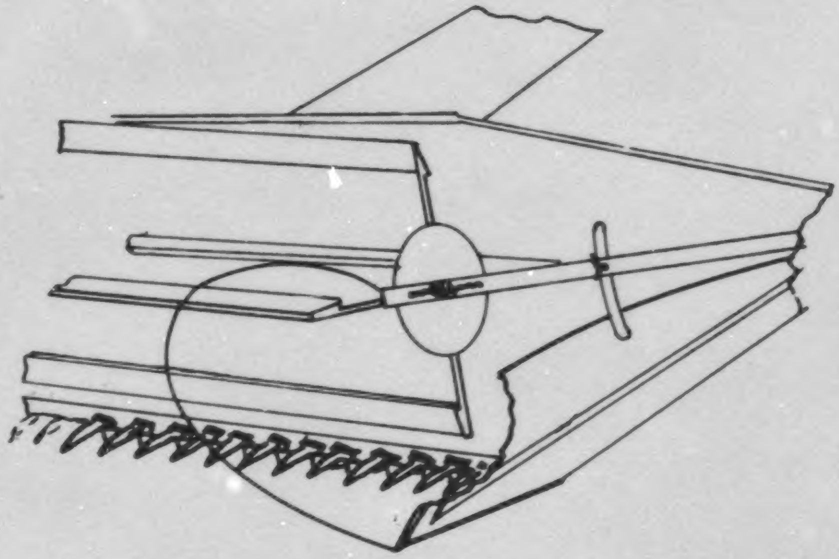
THE REEL SHOULD ENTER THE CROP THE MINIMUM DEPTH NECESSARY TO CONTROL THE CROP.



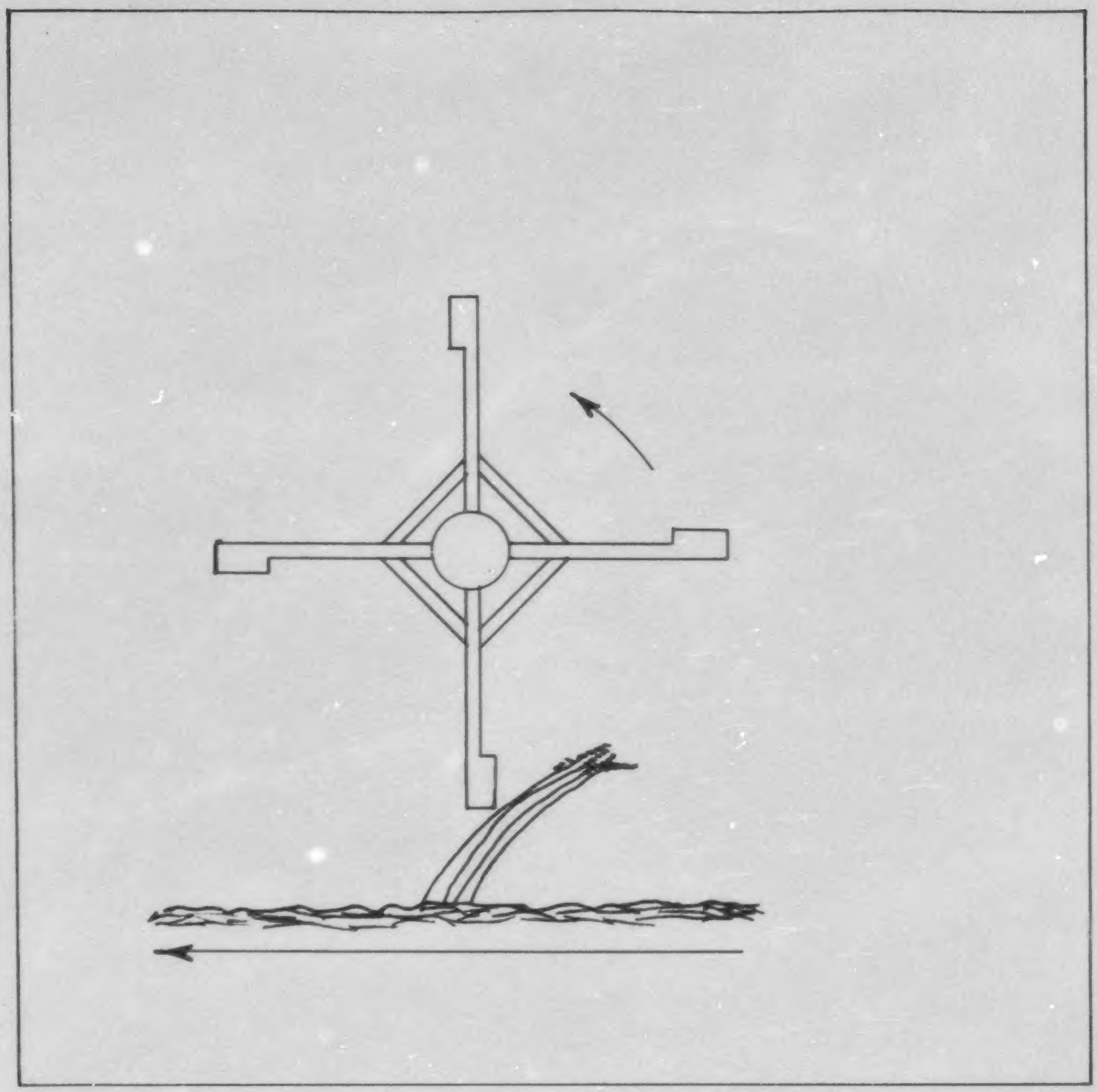
INCORRECT REEL ADJUSTMENT

THE REEL ENTERS THE CROP BEYOND THE MINIMUM DEPTH ALLOWING THE GRAIN HEADS TO BREAK OVER THE REEL BATS AND BE LOST.

T 11



CORRECT REEL POSITION



REEL SPEED TOO FAST

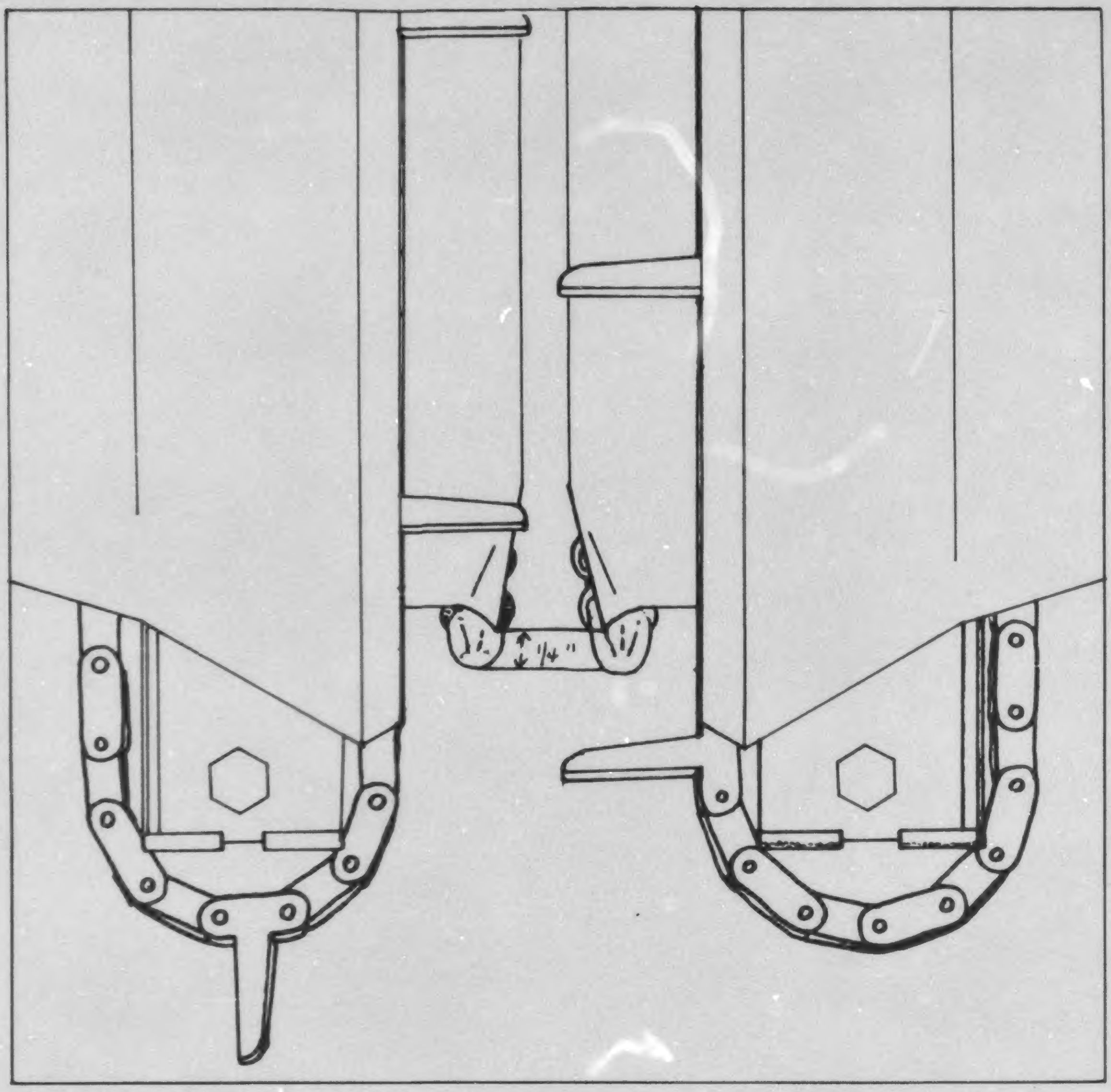
Proper reel speed should be 25% faster than ground speed.
Reel speed is usually 11 RPM per MPH.

MACHINE ADJUSTMENTS TO MINIMIZE HARVEST LOSS WITH CORN

FOR CORN

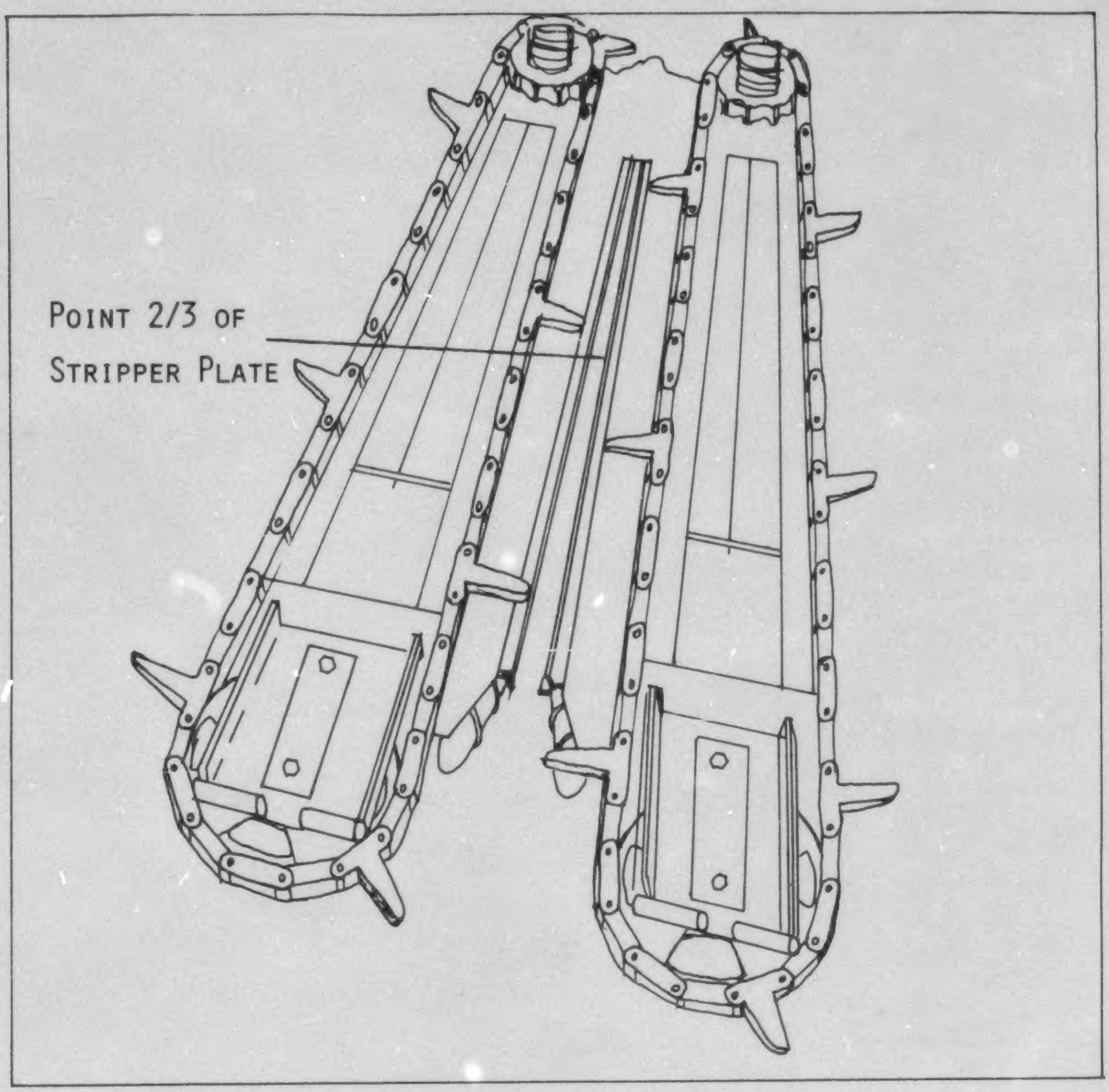
A) MACHINE ADJUSTMENTS -

1. PROPERLY GOVERNED ENGINE SPEED
2. ADJUST THE GATHERING SNOUTS SUCH THAT THE CENTER SNOUT IS JUST TOUCHING THE GROUND WHEN THE GATHERING CHAINS ARE ABOUT 2 INCHES ABOVE THE GROUND. THEN, LOWER EACH SUCCESSIVE SNOUT ABOUT 1 INCH LOWER THAN THE CENTER ONE. THEN, DRIVE WITH THE CENTER SNOUT JUST TOUCHING THE GROUND. THIS WILL ENSURE THAT ALL GATHERING POINTS ARE FLOATING ON THE GROUND EVEN THOUGH THE MACHINE MAY TILT FROM SIDE TO SIDE DUE TO UNEVEN GROUND.
3. OPEN THE STRIPPER PLATES OVER THE BLADE SNAPPING ROLLS AS FAR AS POSSIBLE WITHOUT LETTING AN EAR PASS THROUGH (MAKE SURE ALL ROWS ARE ADJUSTED THE SAME)
4. EXTEND GATHERING CHAIN FLIGHTS AT LEAST 1/4-IN. BEYOND THE LIP OF THE STRIPPER PLATE AT THE FORWARD PORTION OF THE PLATE
5. SET BLADE SNAPPING ROLLS TO PULL THE STALK THROUGH THE STRIPPER PLATE AT A POINT ABOUT 2/3 OF THE WAY UP ON THE STRIPPER PLATE
6. USE CYLINDER SPEED AND CYLINDER-CONCAVE SETTING AS SPECIFIED BY THE MANUFACTURER, AND THEN MAKE ONLY SMALL CHANGES IN SPEED OR CLEARANCE TO OBTAIN THE DESIRED CYLINDER LOSS OF ABOUT 0.2 TO 0.3 BUSHEL PER ACRE



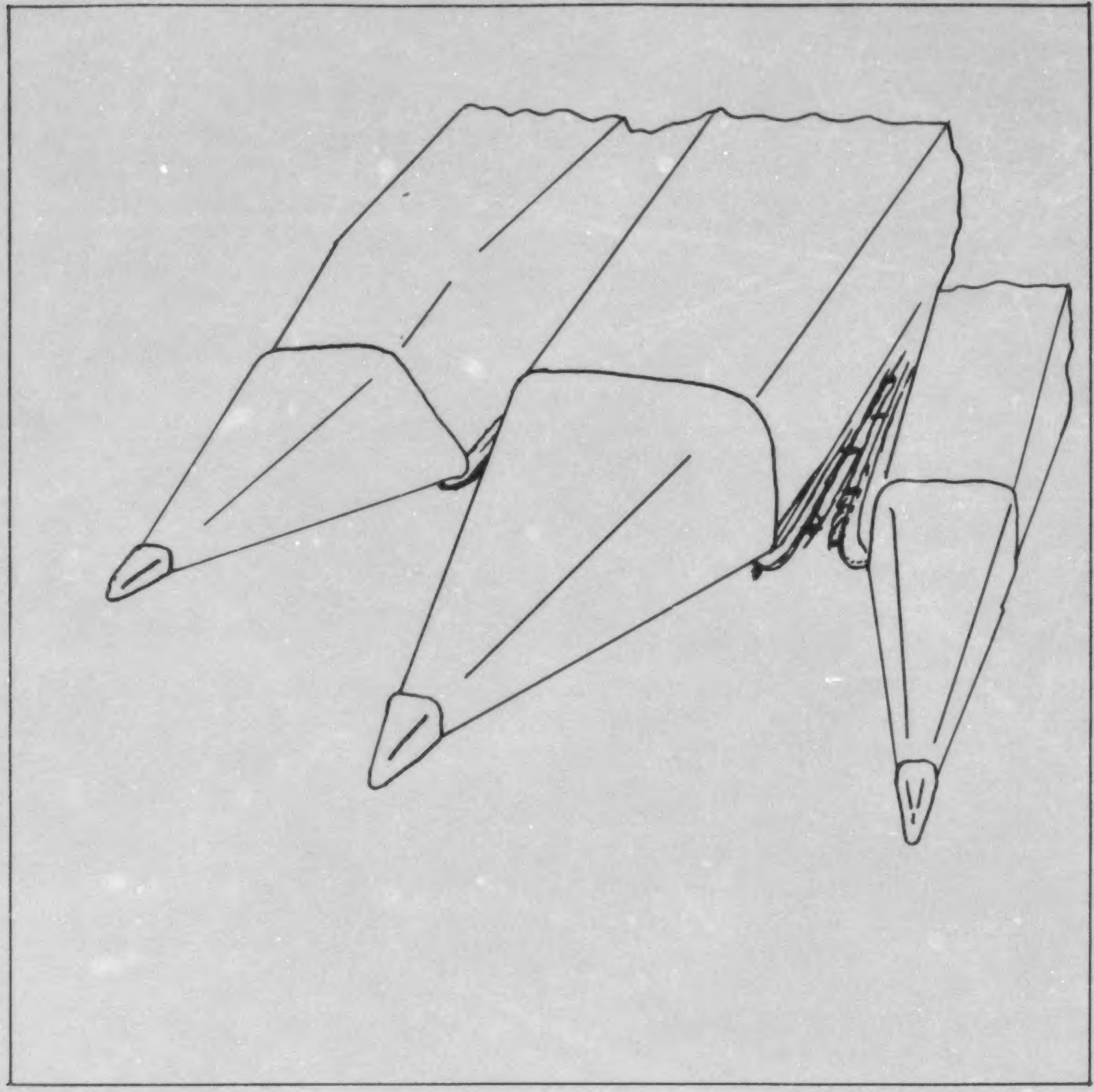
GATHERING CHAIN

GATHERING CHAINS SHOULD EXTEND A MINIMUM 1/4" BEYOND THE LIP OF THE STRIPPER PLATE.


POINT 2/3 OF
STRIPPER PLATE

SNAPPING ROLLS

SNAPPING ROLLS SHOULD PULL THE STALK THROUGH THE STRIPPER PLATE ABOUT 2/3 OF THE WAY UP THE STRIPPER PLATE.

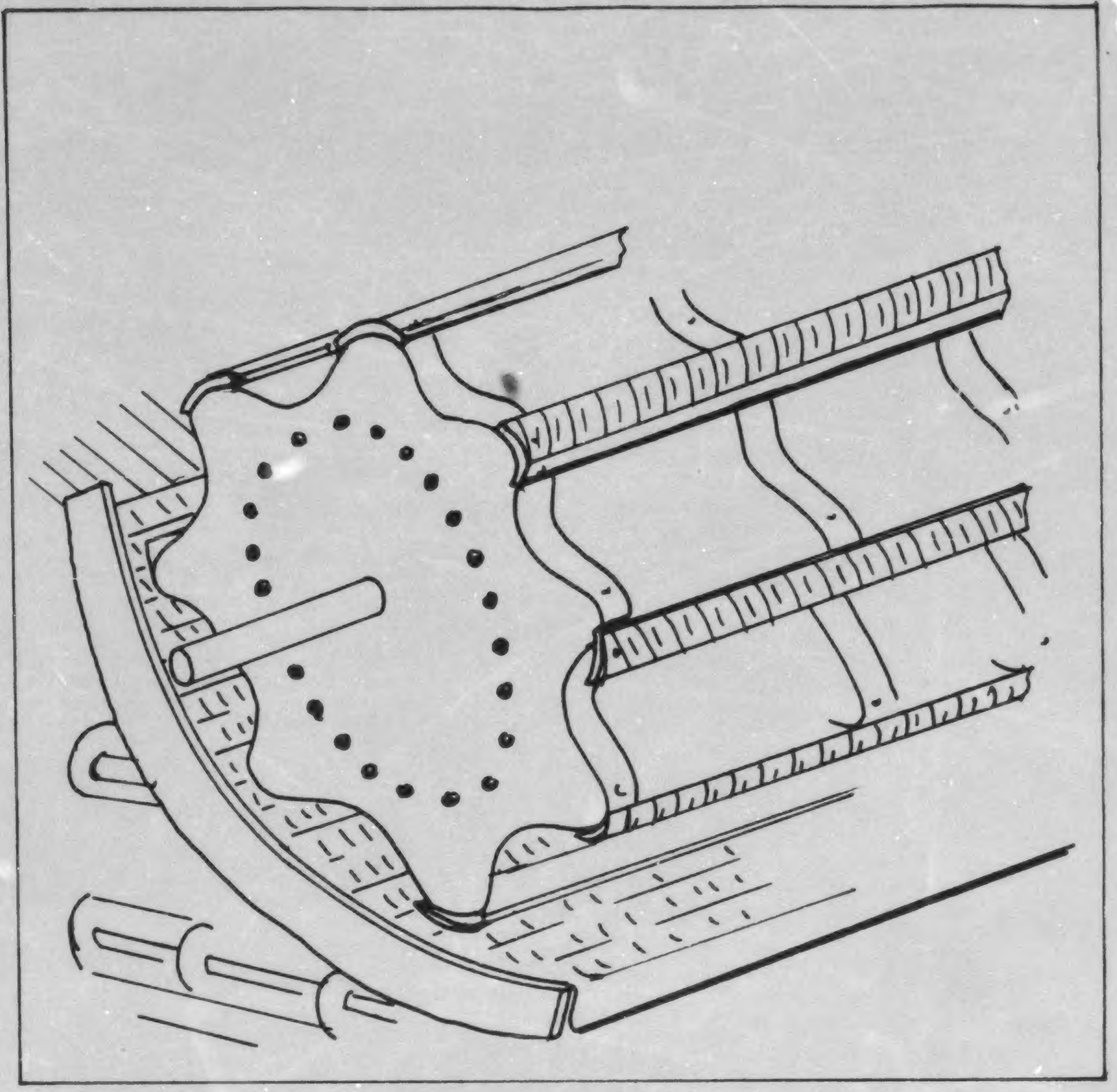


ADJUST THE GATHERING SNOUTS

CENTER SNOUT JUST TOUCHING THE GROUND, THEN LOWER EACH SUCCESSIVE SNOUT ABOUT ONE INCH LOWER THAN THE CENTER ONE.

T 17

CYLINDER SPEED CONTROL



1 - Adjust only when running

2 - 150 to 1500 rpm

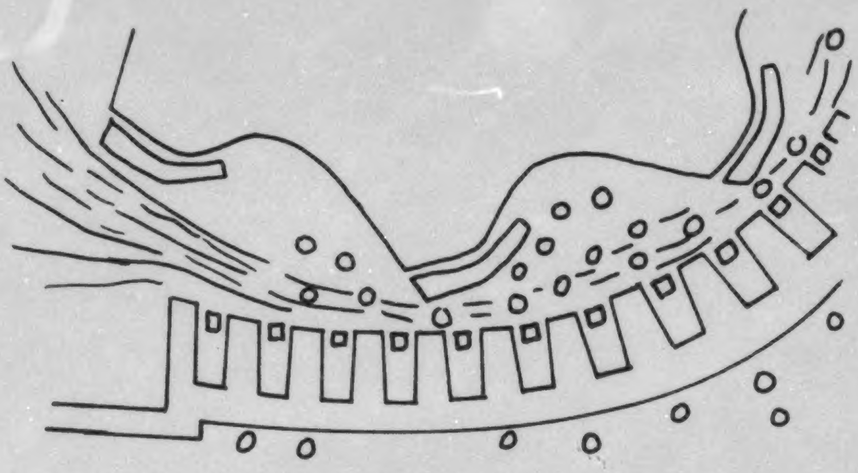
3 - Tachometer needed to determine speed

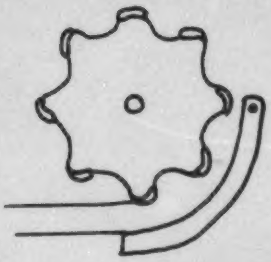
AVERAGE SETTINGS

Corn 400 - 900 rpm

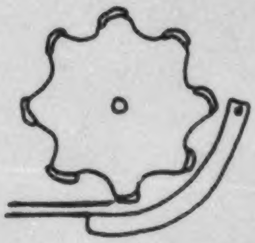
Soybeans 450 - 850 rpm

CONCAVE SPACING CONTROL



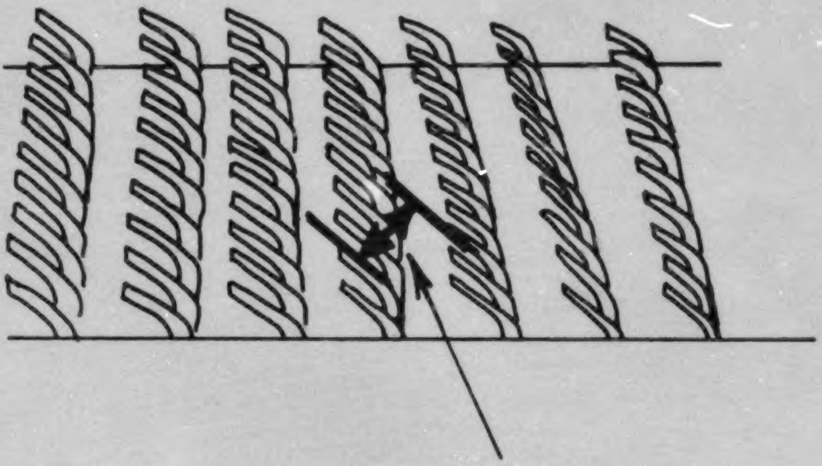


WIDE SPACING FOR
LARGE SEED CROPS



NARROW SPACING FOR
SMALL SEED CROPS

AVERAGE SETTINGS
(Front of Concave)
Corn 1" - 1 1/2"
Soybeans 3/8" - 1"



PERPENDICULAR LOUVER MEASUREMENT

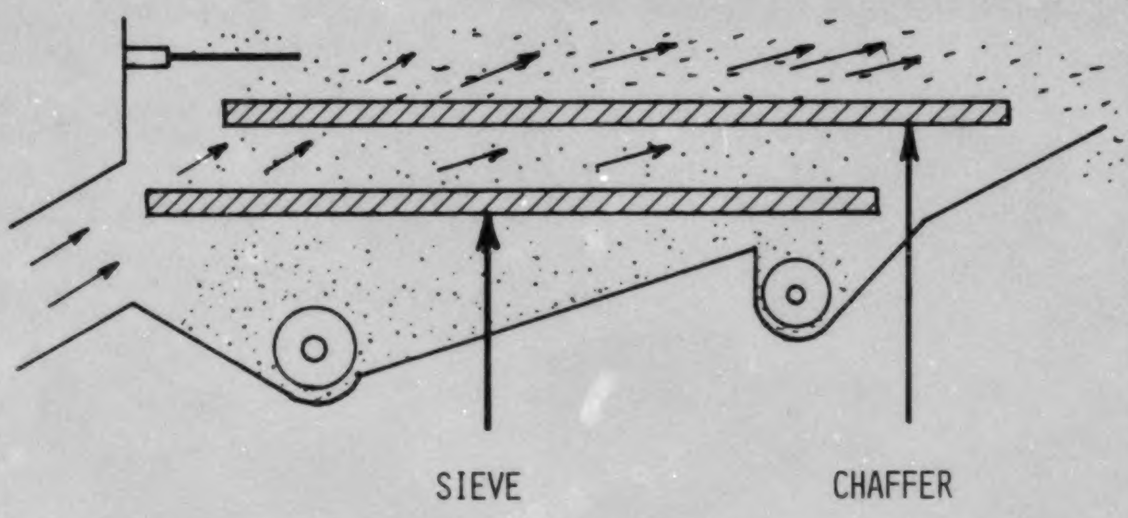
SIEVE

AVERAGE SETTINGS

Corn 1/2" - 5/8"

Soybeans 3/8" - 1/2"

CHAFFER SETTINGS


SIEVE
CHAFFER

CHAFFER

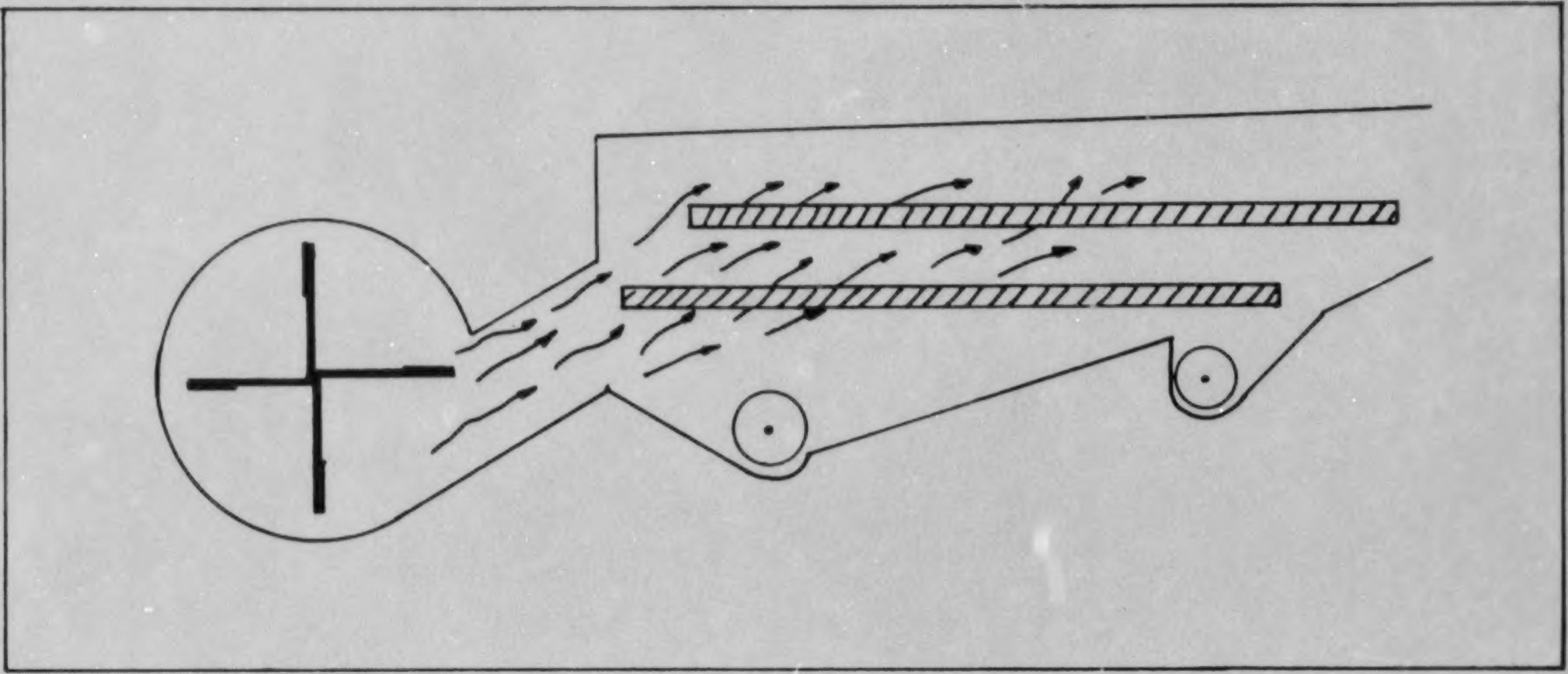
AVERAGE SETTINGS

Corn 7/16" - 5/8"

Soybeans 1/2" - 3/4"

T 18D

FAN SPEED CONTROL



1. Adjust only when running
2. Avoid slow speeds
3. Do not blow out seeds
4. Adjust as recommended

T 18E

Adult Unit No. 5

BIG PACKAGE HAYMAKING

A Resource Unit For Adult Education Classes in Agriculture

Developed by
Bill Massey

Edited by
L. H. Newcomb

Department of Agricultural Education
College of Agriculture and Home Economics
The Ohio State University
Columbus, Ohio 43210

1975

PREFACE

THIS RESOURCE UNIT WAS DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U. S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN
ASSISTANT PROFESSOR

L. H. NEWCOMB
ASSISTANT PROFESSOR

TABLE OF CONTENTS

	PAGE
PREFACE	III
INTRODUCTION	1
STATE SITUATION	3
LOCAL SITUATION	4
OBJECTIVES	4
REFERENCES	5
NEEDED AV EQUIPMENT	5
ALTERNATIVE INTEREST APPROACHES	5
QUESTIONS TO BE ANSWERED	6
LEARNING ACTIVITIES	6
TO SUMMARIZE (NOTE TO TEACHER)	7
APPLICATION	8
APPENDIX A: CONTENT SUMMARY	9
APPENDIX B: INSTRUCTIONAL MATERIALS	14

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATIBLE TO THE LOCAL COMMUNITY.

BIG PACKAGE HAYMAKING

State Situation

During the 1965-70 time period a number of changes have occurred involving acres harvested, yield per acre, and total hay and corn production in Ohio.

Table 1

	Acres	Tons of Hay	Tons Per Acre
1965	1,853,000	3,440,000	1.86
1970	1,440,000	3,010,000	2.09

1965-70 Ohio Agricultural Statistics

Table 2

	Acres	Bushels of Corn	Bushels Per Acre
1965	3,054,000	225,996,000	74.0
1970	3,040,000	240,160,000	79.0

1965-70 Ohio Agricultural Statistics

Tables 1 and 2 show that hay and corn crops occupy a tremendous amount of acreage. Corn is often thought to be "King" among Ohio crops, yet in 1970, hay equalled approximately 47 percent of the total corn acreage. Therefore, hay is important to total farm income and state agricultural income as it relates to land usage.

According to the 1972 Ohio Farm Income Report, cash receipts from the sale of hay was equal to approximately eight percent of the cash receipts from the sale of corn in Ohio ($197,365,000 from corn; $15,500,000 from hay). This may be partly due to the fact that, in the past, little effort had been given to mechanizing hay handling systems as compared to systems for handling small grains and corn. In addition, grain was allotted the more productive land. Also, most hay is raised for on-farm consumption rather than a cash crop as in the case of corn.

Because of the present relationship between grain and livestock prices, Ohio farmers are seeking new ways to manage and feed livestock.

THE "GRASS FATTENING" OF CATTLE IS INCREASING. THE RESULTING ECONOMIC BALANCE COULD MOTIVATE FARMERS TO IMPLEMENT NEW HAY OR FORAGE HANDLING SYSTEMS. MANY NEW TYPES OF SUCH MACHINES ARE NOW AVAILABLE.

LOCAL SITUATION

THE 1965-70 OHIO AGRICULTURAL STATISTICS BULLETIN PRESENTS A DETAILED BREAKDOWN BY COUNTY OF THE NUMBER OF ACRES HARVESTED AND TOTAL PRODUCTION IN TONS FOR HAY. INTRODUCTORY INFORMATION TO BE DISCUSSED SHOULD INCLUDE THE IMPORTANCE OF HAY AS IT RELATES TO OTHER CROPS IN THE COUNTY, AND ITS PLACE IN OTHER OHIO COUNTIES.

IF YOU WILL BE SENDING NOTICES CONCERNING THE TOPIC, TIME AND PLACE OF THIS MEETING, A QUESTIONNAIRE CONTAINING QUESTIONS SUCH AS THE FOLLOWING COULD BE INCLUDED:

QUESTIONS RELATING TO HAY PRODUCTION

IN ORDER TO HELP DETERMINE THE LOCAL SITUATION CONCERNING HAY PRODUCTION AND HAY HANDLING SYSTEMS, PLEASE RESPOND TO THE FOLLOWING QUESTIONS AS THEY RELATE TO YOUR FARM.

1. HOW MANY ACRES OF HAY DO YOU HARVEST EACH YEAR?
2. HOW MANY CUTTINGS DO YOU AVERAGE A YEAR?
3. HOW MANY PEOPLE ARE INVOLVED OR HELP WITH THE HARVESTING?
4. HOW DO YOU HARVEST YOUR HAY?
5. ARE YOUR HAY MACHINES IN GOOD CONDITION?
6. HOW SOON DO YOU PLAN TO REPLACE YOUR HAY PACKAGING MACHINE?
7. WHAT IS/ARE THE HORSEPOWER(S) OF YOUR TRACTOR(S)?

THIS WOULD HELP TO SURVEY THE LOCAL SITUATION ON A MORE PERSONAL NOTE. PARTICIPANTS COULD RETURN THE QUESTIONNAIRE BY MAIL PRIOR TO CLASS FOR DISCUSSION.

OBJECTIVES

THE LEARNER IS TO:

1. LIST ADVANTAGES AND DISADVANTAGES OF NEW HAY PACKAGE SYSTEMS.
2. IDENTIFY VARIOUS TYPES OF BIG PACKAGE HAY HANDLING MACHINES.
3. DESCRIBE THE STEPS OF OPERATION OF FOUR TYPES OF BIG HAY PACKAGE MACHINES.

4. Compare size and kind of package, capacity, and costs of several kinds of hay making equipment.

References

Doane's Agricultural Report, *Big Package Haying Systems*, 3-29-74.

Manufacturers Product Literature: New Holland, Hesston, Stackhand Systems, Farmhand, International Bigroll Baler, Hawk Bilt Roll Baler, Gehl Gehlbale.

1965-70 Ohio Agricultural Statistics.

Parsons, Samuel D., *Big-Package Haymaking (Packaging and Handling Equipment Alternatives)*. West Lafayette, Indiana: Cooperative Extension Service, Purdue University, Publication AE-85, January, 1973.

Van Keuren, R. W.; Parker, C. F.; and Gill, W. E. *Big-Package Forage Handling for Beef Cows*. Wooster, Ohio: Ohio Agricultural Research and Development Center, Research Summary 68, August, 1973.

Needed AV Equipment

Overhead projector, slide projector, screen projector, and chalkboard.

Alternative Interest Approaches

Alternative A. Ask the more experienced farmers to tell how they formerly harvested hay. With the aid of the following chart, find out how much they were able to harvest in one day when they first started harvesting.

(Chalkboard Chart)

	Amount of Hay Harvested in One Day			
Range of Beginning Years	Tons	Acres	Wagon Loads	.....
19___				
19___				
19___				

During that time period:

-- How many people would normally be involved in a day's work?

-- HOW MUCH DID LABOR COST?

-- WHAT KINDS OF MACHINES WERE USED?

-- WHAT WERE SOME MACHINE COSTS?

THEN ASK PARTICIPANTS WHEN THE FIRST SMALL ROUND BALER AND SQUARE BALER WERE AVAILABLE IN THEIR AREA.

ALTERNATIVE B. SURVEY THE CLASS TO DETERMINE IF FARMERS ARE SATISFIED WITH THEIR PRESENT HAY HANDLING SYSTEM. SET UP A CHALKBOARD CHART TO LIST THEIR REASONS UNDER EACH CATEGORY, SUCH AS:

(CHALKBOARD CHART)

OPERATION OF PRESENT HAY HANDLING SYSTEM

SATISFIED	UNSATISFIED
.....	....

QUESTIONS TO BE ANSWERED

THESE AND RELATED QUESTIONS MAY BE DRAWN OUT FROM THE CLASS OR INTRODUCED BY THE TEACHER.

1. WHAT ARE SOME OF THE FEATURES OF THE BIG PACKAGE HAY MACHINES?

2. HOW DO SOME OF THE MAJOR TYPES OF MACHINES OPERATE OR FUNCTION?

3. HOW DO THESE MACHINES COMPARE IN SIZE AND KIND OF PACKAGE, CAPACITY, MACHINE COSTS, TRACTOR HORSEPOWER REQUIREMENTS, SPECIAL FEATURES, ETC.?

4. WHAT ARE ADVANTAGES AND DISADVANTAGES OF THE NEW HAY PACKAGE SYSTEMS?

LEARNING ACTIVITIES

1. WHAT ARE SOME OF THE FEATURES OF THE BIG PACKAGE HAY MACHINES?

REFER TO 2X2 SLIDES OF THE VARIOUS MACHINES UNDER DISCUSSION. (AVAILABLE FROM OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, ROOM 254, 2120 FYFFE ROAD, COLUMBUS, OHIO 43210.)

2. HOW DO SOME OF THE MAJOR TYPES OF MACHINES OPERATE OR FUNCTION?

DISCUSS TRANSPARENCIES:

T-1: COMPONENTS OF HAWK BILT BALER

T-2: OPERATING CYCLE OF THE HAWK BILT BALER

T-3: COMPONENTS OF VERMEER BALERS

T-4: OPERATING CYCLE OF VERMEER BALERS

T-5: COMPONENTS OF HESSTON 10

T-6: OPERATING CYCLES OF THE HESSTON STACKHAND 10

T-7: COMPONENTS OF NEW HOLLAND 850 ROUND BALER

T-8: OPERATING CYCLES OF NEW HOLLAND 850 ROUND BALER

(DISTRIBUTE HANDOUT #1, "DISCUSSION OF BALER OPERATING CYCLES.")

3. HOW DO THESE MACHINES COMPARE IN SIZE AND KIND OF PACKAGE, CAPACITY, MACHINE COSTS, TRACTOR HORSEPOWER REQUIREMENTS, SPECIAL FEATURES, ETC.?

DISTRIBUTE THE HANDOUT #2, "COMPARISON CHART," FOR ASSISTANCE IN MAKING MACHINE COMPARISONS.

4. WHAT ARE THE ADVANTAGES AND DISADVANTAGES OF THE NEW HAY PACKAGE SYSTEMS?

USE HANDOUT #5 TO COMPARE COMMON MACHINE FEATURES.

WITH CLASS PARTICIPATION, DEVELOP A LIST ON THE CHALKBOARD OR ON A BLANK TRANSPARENCY. ITEMS TO BE INCLUDED:

ADVANTAGES	DISADVANTAGES
1. BY STOCKPILING THE FEED IN THE FIELD RATHER THAN HARVESTING, STORING, AND HANDLING THE FORAGE SEVERAL TIMES, THE COST AND LABOR OF WINTER FEEDING CAN BE SUBSTANTIALLY REDUCED.	1. BIGGER TRACTOR MIGHT BE REQUIRED.
2. COSTS FOR BEDDING CAN BE ELIMINATED.	2. SOME LOSS OF FEED IN FIELD DUE TO DECOMPOSITION OCCURS.
3. EXPENSIVE BARNS ARE NOT REQUIRED TO STORE HAY.	

TO SUMMARIZE (NOTE TO TEACHER)

THERE ARE A FEW SPECIFIC CLAIMS ABOUT SOME OF THE BIG HAY PACKAGE MACHINES ON THE MARKET THAT RESEARCH HAS NOT VERIFIED TO DATE AS BEING OUTSTANDING BREAKTHROUGHS IN THE INDUSTRY. ALL OF THE MACHINES IN THIS LESSON MAKE HAY OF DESIRABLE QUALITY PROVIDED GOOD HAY IS MOWED AND RAKED. THESE MACHINES ARE NOT DESIGNED TO MAKE "GOOD" HAY OUT OF "POOR" HAY. GOOD MANAGEMENT PRACTICES IN ESTABLISHING A MEADOW, CONTROLLING WEEDS AND INSECTS, FERTILIZING AND LIMING, AND HAY MAKING SCHEDULES ARE A MUST FOR SUCCESSFUL AND PROFITABLE UTILIZATION OF THESE MACHINES.

BASICALLY THIS LESSON IS DESIGNED TO GIVE THE CLASS MEMBERS A LOOK AT SOME OF THESE MACHINES, TO SEE HOW SOME OF THE MACHINES OPERATE AND TO COMPARE VARIOUS FEATURES AND REQUIREMENTS OF THE MANY MACHINES ON THE MARKET.

IT SHOULD ALSO BE NOTED THAT MANY FARMERS HAVE IMPLEMENTED OTHER TYPES OF HAY MAKING AND HANDLING SYSTEMS NOT MENTIONED IN THIS LESSON. FOR THEM, NEW TECHNIQUES AND METHODS OF HAY MAKING DESCRIBED IN THIS LESSON WILL BECOME USEFUL WHEN THEY DECIDE IT IS TIME TO REPLACE THEIR WORN-OUT EQUIPMENT WITH SOMETHING NEW OR "BETTER."

APPLICATION

A. CONDUCT A FIELD TRIP TO ONE OR MORE FARM(S) THAT HAVE BIG HAY PACKAGE MACHINES IN ORDER THAT OTHERS CAN SEE FIRSTHAND A MACHINE, A HAY PACKAGE MADE BY THE MACHINE, AND INFORMALLY DISCUSS MANAGEMENT PRACTICES THAT ARE UNIQUE TO THE SYSTEM.

B. TAKE A FIELD TRIP TO ONE OF THE OSU RESEARCH STATIONS THAT IS CONDUCTING RESEARCH WITH VARIOUS MACHINES AND FEEDING TRIALS.

C. THROUGH SUPERVISORY VISITS AND INDIVIDUAL CONFERENCES GET FARMERS TO SERIOUSLY CONSIDER THE FEASIBILITY OF THIS PRACTICE.

C. PLAN A FIELD DAY IN YOUR COMMUNITY WHERE THE VARIOUS SYSTEMS WILL BE DEMONSTRATED. (MAY WISH TO COOPERATE WITH YOUR LOCAL EXTENSION OFFICE.)

1. DEMONSTRATE OPERATING EFFICIENCY
2. COMPARE HAY QUALITY (LEAFINESS, PALATABILITY, ETC.)
3. DEMONSTRATE MACHINE VERSATILITY
4. COMPARE PRODUCT HANDLING AND WEATHER RESISTANCE
5. PROVIDE INFORMATION PERTAINING TO THE ECONOMICS OF EACH SYSTEM.

APPENDIX A

CONTENT SUMMARY

(THE INFORMATION IN THIS LESSON IS FOR EDUCATIONAL PURPOSES ONLY WITH NO IMPLIED DISCRIMINATION OR ENDORSEMENT OF ANY MACHINE.)

1. HAWK BILT MODEL 480 BALER
2. VERMEER MODEL 605 AND MODEL 706 BALERS
3. HESSTON STACKHAND 10 STACKER
4. NEW HOLLAND 850 ROUND BALER

HAWK BILT MODEL 480 BALER

THIS MACHINE IS THE SIMPLEST OF THE THREE TYPES OF UNITS AVAILABLE IN THE "UNDER-3-TON-PACKAGE" CATEGORY. IT HAS BASICALLY ONE MOVING PART, THE RADDLE; AND A SELF-CONTAINED HYDRAULIC SYSTEM, WHICH IS POWER-TAKE-OFF-(PTO) DRIVEN FROM THE TRACTOR. WHEN THE HYDRAULIC CONTROL ROPE IS PULLED, THE RADDLE BECOMES "FREE WHEELING" AND THE TAILGATE AUTOMATICALLY OPENS. LIKEWISE, WHEN THE HYDRAULIC CONTROL ROPE IS RELEASED, THE TAILGATE BEGINS TO CLOSE. THE RADDLE IS AUTOMATICALLY ENGAGED WHEN THE TAILGATE REACHES ITS FULL-DOWN POSITION. THE IDLER ARM (SHAFT AND SPROCKET ASSEMBLY) IS SPRING-LOADED TO MAINTAIN THE APPROPRIATE RADDLE TENSION ON THE BALE.

IN "OPERATE" POSITION, THE TRACTOR MAY STRADDLE THE WINDROWS (WIDE FRONT-AXLE RECOMMENDED) OR BE OFFSET TO THE LEFT SIDE. WITH NORMAL-SIZE WINDROWS, THE UNIT MUST BE "WEAVED" BACK AND FORTH TO FORM THE FULL 7-FOOT LENGTH OF THE BALE. NO SPECIAL WINDROWING PROCEDURES ARE NEEDED, BUT A "SQUARE-SIDED" WINDROW WILL BE OF HELP IN "SQUARING-OUT" THE ENDS OF THE BALE.

TO PROPERLY FORM THE HAWK BILT BALE, RADDLE SPEED MUST BE TIMED TO THE PARTICULAR GROUND SPEED BEING USED. RADDLE SPEED IS INFINITELY VARIABLE THROUGH A FLOW-DIVIDER VALVE IN THE SELF-CONTAINED HYDRAULIC SYSTEM. ONCE THIS IS SET, IT SHOULD NOT HAVE TO BE ADJUSTED AGAIN FOR THAT PARTICULAR GROUND SPEED.

THE FIELD SURFACE FORMS THE BOTTOM SIDE OF THE "BALE CHAMBER" (THE BALE IS ACTUALLY ROLLED ALONG ON THE GROUND). TURNING SHARP CORNERS WITH THIS UNIT CAN BE A PROBLEM SINCE THE OUTER END OF THE BALE MUST TRAVEL FARTHER THAN THE INNER END. SOME OPERATORS SAY THE SOLUTION IS TO INTERMITTENTLY PULL THE HYDRAULIC CONTROL ROPE AS THE TURN IS BEING MADE.

ANOTHER CONSIDERATION WITH THE UNIQUE HAWK BILT "BALE CHAMBER" IS THAT THE BALE CANNOT BE TRANSPORTED LONG DISTANCES IN THE BALER ONCE IT IS MADE. THIS NEED NOT BE A SERIOUS LIMITATION, HOWEVER, SINCE OTHER MEANS OF BALE TRANSPORT ARE AVAILABLE. BECAUSE THE BALE IS NOT TIED, THE OUTER 6- TO 10-INCH LAYER OF HAY INITIALLY MAY BE RELATIVELY LOOSE AND FLUFFY. THEREFORE, IT IS RECOMMENDED THAT BALES BE ALLOWED TO "SETTLE" FOR A WEEK OR SO BEFORE BEING MOVED.

EXPERIENCED OPERATORS INDICATE THE HAWK BILT BALER IS BASICALLY TROUBLE-FREE. ALTHOUGH IT HAS BEEN NOTED THAT LONG-STEMMED MATERIAL BALES "BETTER" THAN SHORT-STEMMED MATERIAL, THIS BALER HAS PROVEN TO BE FUNCTIONALLY SOUND UNDER A VARIETY OF OPERATING CONDITIONS, INCLUDING "HIGH-MOISTURE" BALING (WHICH IS NOT A RECOMMENDED PRACTICE). BOTH GRASSES AND LEGUMES HAVE BEEN SUCCESSFULLY BALED. BALING CAPACITY DOES NOT APPEAR TO BE A LIMITATION, WITH FARMERS REPORTING RANGES FROM 5 OR 6 BALES PER HOUR UP TO 12 BALES PER HOUR.

VERMEER MODEL 605 AND MODEL 706 BALERS

THE VERMEER BALERS USE SPLICED BELTS TO FORM THE BALE. THE UPPER BELTS ARE ABOUT 4 INCHES WIDE, WHEREAS THE BOTTOM BELT EXTENDS THE FULL WIDTH OF THE BALE CHAMBER. TENSION IN THE UPPER BELTS, AND THUS DENSITY OF THE BALE, IS CONTROLLED HYDRAULICALLY THROUGH CYLINDERS CONNECTED TO THE IDLER ARM AND A PRESSURE CONTROL VALVE ON THE BALER. THE BELTS ARE PTO-DRIVEN FROM THE TRACTOR.

IN "OPERATE" POSITION, THE TRACTOR STRADDLES THE WINDROW (WIDE FRONT AXLE RECOMMENDED). AS WITH THE HAWK BILT MACHINE, THE VERMEER BALERS MUST BE "WEAVED" BACK AND FORTH ON THE WINDROW TO PROPERLY FORM THE BALE. LIKEWISE, A "SQUARE-SIDED" WINDROW HELPS IN PRODUCING SQUARE CORNERS AT THE ENDS OF THE BALE.

WHEN THE BALE REACHES THE MAXIMUM SIZE DESIRED, THE OPERATOR USES A PULL ROPE TO SWING THE TWINE DELIVERY TUBE INTO POSITION. WHEN THE TWINE STARTS INTO THE BALE, FORWARD TRAVEL IS STOPPED, AND THE TYING OPERATION IS COMPLETED BY MANUALLY DIRECTING THE TWINE DELIVERY TUBE FROM ONE END OF THE BALE TO THE OTHER. THE BELTS ARE THEN STOPPED AND THE TWINE CUT USING A SECOND PULL ROPE. ONCE THE TAILGATE IS RAISED (USING THE TRACTOR'S HYDRAULIC SYSTEM), THE BOTTOM BELT IS ENGAGED JUST ENOUGH TO EJECT THE BALE.

THOUGH THE TWINE-TYING OPERATION IS NOT AN ABSOLUTE NECESSITY, MOST VERMEER OPERATORS HAVE USED IT. THE AMOUNT OF TWINE REQUIRED DEPENDS ON THE NUMBER OF "WRAPS," (USUALLY BETWEEN 5 AND 10 PER BALE). WITH THE MODEL 605 BALER (6-FOOT DIAMETER BALE), EACH TWINE WRAP REQUIRES ABOUT 19 FEET OF TWINE; WITH THE MODEL 706 BALER (7-FOOT DIAMETER BALE), EACH WRAP REQUIRES ABOUT 22 FEET OF TWINE.

HAVING THE BALE TIED PROBABLY IMPROVES THE WEATHER-RESISTANCE CHARACTERISTICS OF THE VERMEER BALE AS WELL AS ITS HANDLING CHARACTERISTICS, AT LEAST INITIALLY. A FIRM, TIED BALE WILL ROLL -- SO ON HILLY TERRAIN THE OPERATOR MUST BE SOMEWHAT SELECTIVE AS TO WHERE HE WILL EJECT BALES FROM THE BALER.

SINCE THE BALE IS FORMED ABOVE THE GROUND, IT CAN BE TRANSPORTED SHORT DISTANCES IN A VERMEER BALER. SOME USERS POSITION BALES AT THE PERIMETER OF THE FIELD, ALONG ONE END OF THE FIELD, AS OPPOSED TO EJECTING THE BALES RANDOMLY OVER THE FIELD AS THEY ARE MADE. THIS CAPABILITY NEED NOT BE OVEREMPHASIZED, HOWEVER, SINCE A NUMBER OF SIMPLE, INEXPENSIVE BALE-MOVING TECHNIQUES ARE AVAILABLE.

A FEW MECHANICAL PROBLEMS HAVE BEEN REPORTED BY VERMEER BALER OWNERS. THESE HAVE USUALLY BEEN MINOR AND MIGHT BE ATTRIBUTED TO THE FACT THAT THE BALER HAS BEEN IN USE FOR ONLY A FEW YEARS. SOME OWNERS SUGGEST THAT A SIMPLE BELT-SPLICING KIT, AVAILABLE FROM VERMEER, IS A GOOD INVESTMENT.

FUNCTIONALLY, THE VERMEER BALERS HAVE PERFORMED UP TO EXPECTATIONS. SOME PROBLEMS HAVE BEEN REPORTED IN GETTING THE BALE STARTED (STARTED

ROLLING) WHEN HAY MOISTURE IS ABOVE NORMAL BALING MOISTURES; HOWEVER, IT IS NOT A RECOMMENDED PRACTICE TO BALE WHEN THERE IS EXCESS MOISTURE. BOTH GRASSES AND LEGUMES HAVE BEEN SUCCESSFULLY BALED. BALING CAPACITY APPEARS TO BE AS HIGH OR SLIGHTLY HIGHER THAN CONVENTIONAL BALING CAPACITY, I.E., GROUND SPEED MAY BE FASTER THAN CONVENTIONAL BALING, BUT THE BALER IS STOPPED FOR TYING AND BALE EJECTION.

HESSTON STACKHAND 10 STACKER

THE HESSTON STACKER USES A COMPRESSION CANOPY AT THE TOP OF THE STACKING CHAMBER TO "PRESS" EACH STACK. THIS RESULTS IN A STACK DENSITY (LBS./CU.FT.) HIGHER THAN THAT OBTAINED WITH LONG, LOOSE HAY STACKING SYSTEMS. THE HIGHER DENSITY PLUS THE "TOPPED-OUT" SHAPE PROVIDED BY THE CANOPY IMPROVES THE WEATHER RESISTANCE CHARACTERISTICS OF THE STACKS.

THE COMPRESSION CANOPY IS HYDRAULICALLY OPERATED. WHEN IN THE FULL-UP POSITION, THE HAY DEFLECTOR IS FLAT AGAINST THE CANOPY. LOWERING THE CANOPY 3-4 INCHES ALSO LOWERS THE HAY DEFLECTOR, WHICH ALLOWS THE OPERATOR SOME DIRECTIONAL CONTROL OF THE HAY ENTERING THE STACK CHAMBER.

DURING THE STACKING OPERATION, THE TRACTOR STRADDLES THE WINDROW (WIDE FRONT AXLE RECOMMENDED). THE PICKUP PADDLES ARE PTO-DRIVEN FROM THE TRACTOR. THE ENTIRE PICKUP ASSEMBLY (STEEL PADDLES, DRIVESHAFT, AND DELIVERY SPOUT) IS CARRIED BY A FULL-LENGTH GAUGE ROLLER THAT ADJUSTS FOR OPERATING HEIGHT. THE PICKUP ASSEMBLY IS HYDRAULICALLY RAISED AND SAFETY-LOCKED FOR TRANSPORT.

THE OPERATOR USES TWO PULL ROPES DURING STACK UNLOADING. THE FIRST IS PULLED WHEN THE CANOPY IS IN THE DOWN POSITION. THIS SWINGS A SPRING-LOADED ROCKER-SHAFT INTO POSITION SO THAT, AS THE CANOPY IS RAISED, THE TAILGATE IS MECHANICALLY UNLATCHED AND SWUNG OPEN. THE SECOND PULL ROPE TIGHTENS THE DRIVE BELT TO THE UNLOAD CHAIN. THE TRACTOR AND STACKER SHOULD BE MOVING SLOWLY FORWARD WHEN THE UNLOAD CHAIN IS ENGAGED. MATCHING GROUND SPEED AT THIS POINT WITH THE SPEED OF THE UNLOAD CHAIN IS CRITICAL. (MISMATCHING IN ONE DIRECTION TENDS TO PULL THE STACK APART WHEN IT CONTACTS THE GROUND; MISMATCHING IN THE OTHER MAY CAUSE THE STACK TO TOPPLE OVER.)

HESSTON STACKS NEED NOT BE UNLOADED IN THE FIELD WHERE MADE. SOME USERS MOVE THEM IN THE STACKER TO A FEEDING SITE OR CONCENTRATED STORAGE AREA. OTHERS PREFER TO UNLOAD THEM AS MADE, AND THEN USE A SPECIAL STACK MOVER AT A LATER DATE. SOME OPERATORS SUGGEST THE STACKS SHOULD "SETTLE" FOR A FEW DAYS BEFORE MOVING THEM; OTHERS SAY THIS IS NOT NECESSARY.

FEW MECHANICAL PROBLEMS HAVE BEEN REPORTED BY USERS OF THE HESSTON STACKHAND 10. IF THE OPERATOR TRIES TO PUT TOO MUCH HAY IN A SINGLE STACK, HE HAS TROUBLE UNLOADING THE STACK--BUT THIS USUALLY HAPPENS JUST ONCE TO A GIVEN OPERATOR. THE SAME PROBLEM CAN OCCUR WHEN THE HAY MOISTURE IS HIGHER THAN NORMAL BALING MOISTURE.

STACKING CAPACITY, AS REPORTED BY HESSTON, IS IN THE RANGE OF 4-6 TONS PER HOUR. THIS, OF COURSE, WILL DEPEND ON A NUMBER OF FACTORS: HOW THE HAYFIELD IS RAKED, TRACTOR AND GROUND SPEED USED, NUMBER OF "PRESSES" PER STACK, UNLOADING METHOD (WHERE MADE VS. HAULING ELSEWHERE), ETC. BOTH GRASSES AND LEGUMES HAVE BEEN STACKED SUCCESSFULLY WITH THE STACKHAND 10. IF STACKS ARE TO BE MOVED SOON AFTER BEING MADE, THEY WILL TEND TO HOLD TOGETHER BETTER IF SOME LEGUME IS PRESENT.

BECAUSE OF THE PADDLE PICKUP, THE HESSTON STACKER CAN BE USED FOR DIRECT, SINGLE-PASS PACKAGING OF CORNSTALKS AND OTHER CROP RESIDUES. PRELIMINARY INVESTIGATIONS INDICATE THAT CORNSTALKS SHOULD NOT BE PACKAGED UNTIL AFTER THE FIRST KILLING FREEZE IN ORDER TO INSURE GOOD STORAGE AND MAINTAINING STACK CHARACTERISTICS. SOME DAIRYMEN ALSO REPORT USING THE HESSTON STACKER SUCCESSFULLY FOR GREEN CHOPPING. WHEN THIS IS DONE, THE "PRESSING" CYCLE WITH THE COMPRESSION CANOPY IS OMITTED.[1]

NEW HOLLAND 850 ROUND BALER

THIS MACHINE IS SIMILIAR IN MANY RESPECTS TO THE VERMEER BALER. THE BALE IS CARRIED OFF THE GROUND AND IS MECHANICALLY EJECTED FROM THE BALE CHAMBER BY THE OPERATOR. HOWEVER, THIS MACHINE HAS CHAINED BARS TO DO THE WRAPPING OF THE HAY INSTEAD OF BELTS AS IS FOUND IN THE VERMEER. SINCE ALL OF THE CHAINS ARE KEPT TIGHT HYDRAULICALLY AS THE BALE IS FORMED, IT IS NOT NECESSARY TO WEAVE THE WINDROWS IN ORDER TO KEEP THE CHAINS EVENLY TIGHT.

---

[1] PARSONS, SAMUEL D., BIG-PACKAGE HAYMAKING (PACKAGING AND HANDLING EQUIPMENT ALTERNATIVES). WEST LAFAYETTE, INDIANA: COOPERATIVE EXTENSION SERVICE, PURDUE UNIVERSITY, PUBLICATION AE-85, JANUARY, 1973.

APPENDIX B

INSTRUCTIONAL MATERIALS

(THE PRODUCT LITERATURE IN THIS LESSON IS FOR EDUCATIONAL PURPOSES ONLY WITH NO IMPLIED DISCRIMINATION OR ENDORSEMENT OF ANY MACHINE.)

SLIDES

VERMEER 605 B, INTERNATIONAL BIGROLL 241, GEHL GEHLBALE 1500, HAWK BILT 480, HESSTON STACKHAND 10, AND HAYBUSTER STACK-EZE 1400

HANDOUTS

H-1: HAWK BILT BALER OPERATING CYCLE

H-2: VERMEER BALER OPERATING CYCLE

H-3: HESSTON STACKHAND 10 OPERATING CYCLE

H-4: NEW HOLLAND 850 OPERATING CYCLE

H-5: COMPARING FEATURES OF MACHINES

TRANSPARENCIES

T-1: COMPONENTS OF HAWK BILT BALER

T-2: OPERATING CYCLE OF THE HAWK BILT BALER

T-3: COMPONENTS OF VERMEER BALER

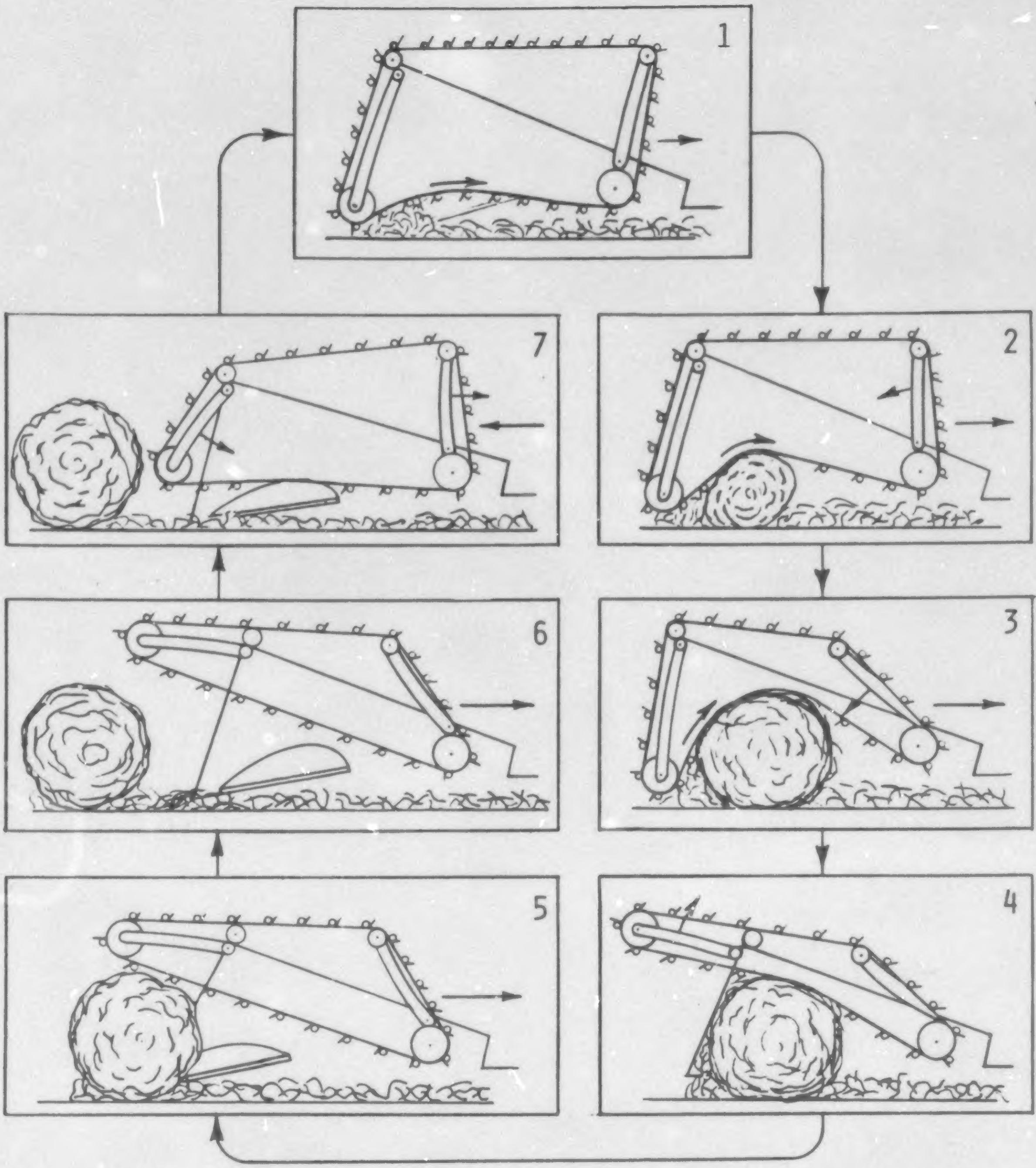
T-4: OPERATING CYCLE OF THE VERMEER BALER

T-5: COMPONENTS OF HESSTON 10

T-6: OPERATING CYCLES OF THE HESSTON STACKHAND 10

T-7: COMPONENTS OF NEW HOLLAND 850 BALER

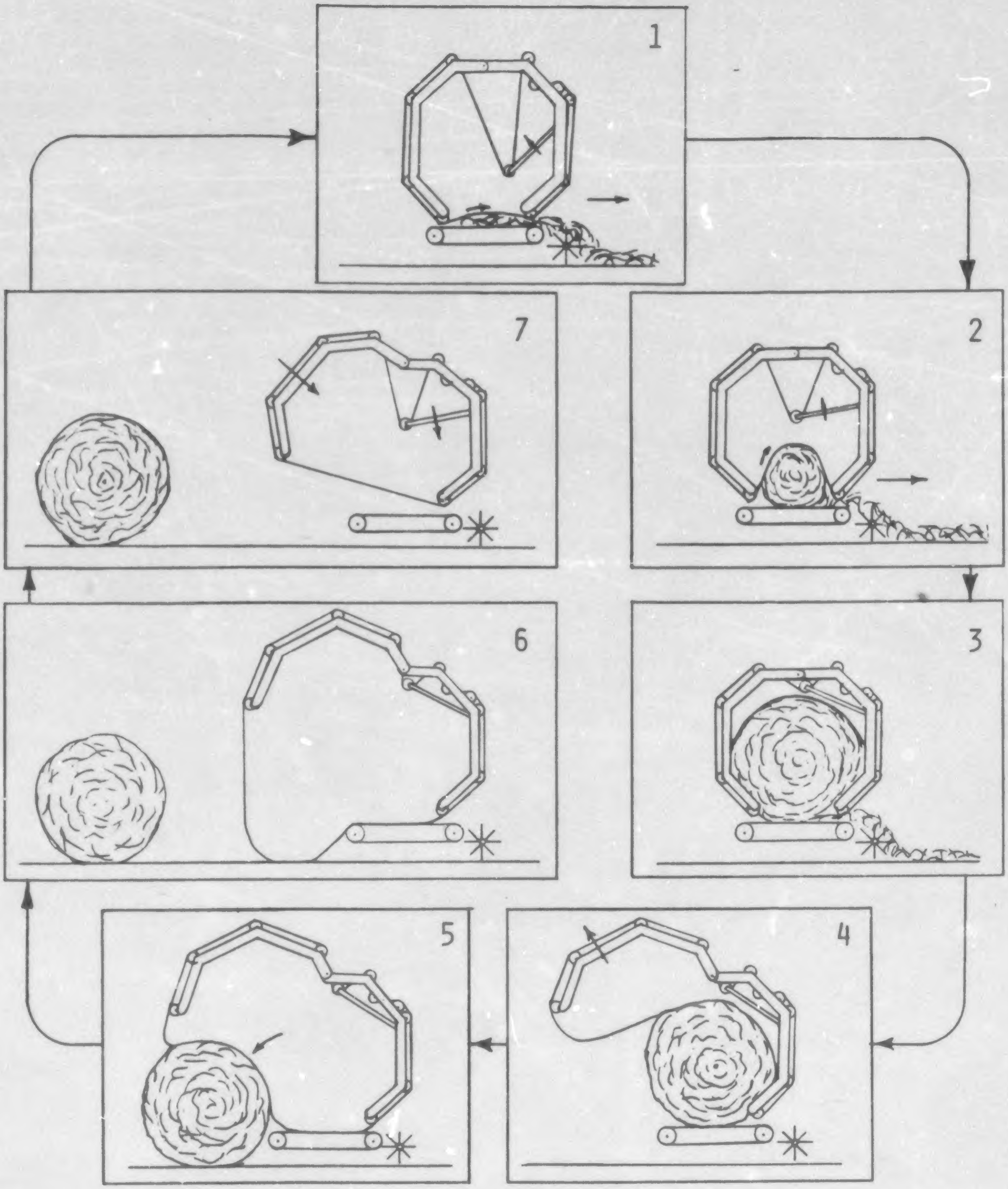
T-8: OPERATING CYCLE OF NEW HOLLAND 850 BALER



OPERATING CYCLE OF THE HAWK BILT BALER

OPERATING CYCLE OF THE HAWK BILT BALER

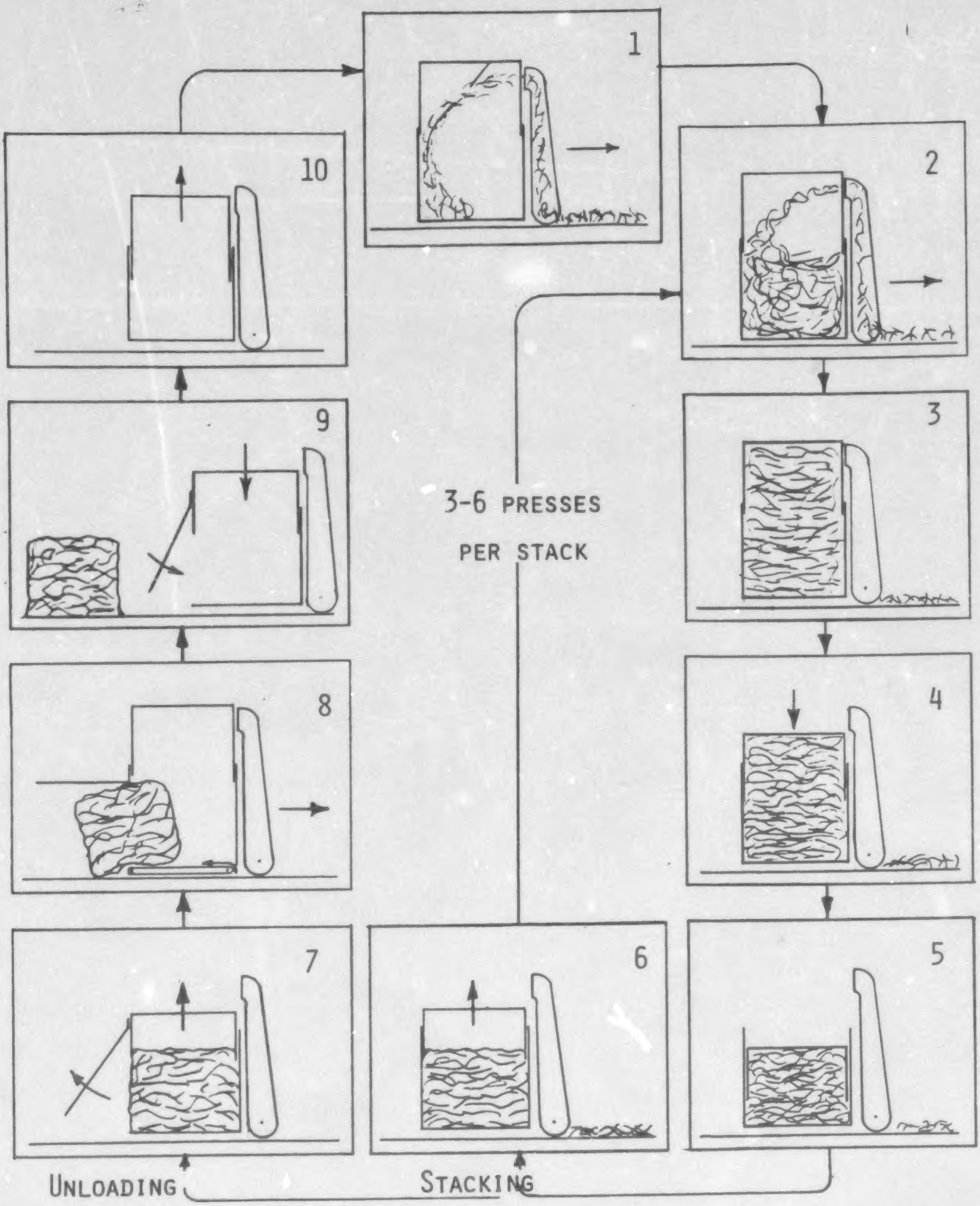
BALE STARTS (1) WITH RADDLE ON BALE CHAMBER GUIDES, IDLER ARM IN FULL-FORWARD POSITION. IDLER ARM PIVOTS (2) AS BALE SIZE INCREASES. WHEN BALE IS FULL SIZE (3) IDLER ARM IS NEAR FULL-REAR POSITION. FORWARD TRAVEL IS STOPPED (4) AND TAILGATE RAISED, WHICH DISENGAGES RADDLE. RADDLE IS FREE TO ROTATE AS BALER IS PULLED CLEAR OF THE BALE (5, 6). TAILGATE IS LOWERED (7) AND BALER BACKED-UP TO GET HAY IMMEDIATELY IN FRONT OF THE BALE. RADDLE STARTS WHEN TAILGATE REACHES DOWN POSITION, AND THE NEXT BALE IS STARTED (1).



OPERATING CYCLE OF VERMEER BALERS

OPERATING CYCLE OF VERMEER BALERS

BALE STARTS (1) WITH IDLER ARM IN FULL-DOWN POSITION. IDLER ARM PIVOTS (2) AS BALE SIZE INCREASES. AS BALE APPROACHES FULL SIZE (IDLER ARM NEAR FULL-UP POSITION), TWINE FED INTO OUTER BALE LAYER, THEN FORWARD TRAVEL STOPPED (3) TO COMPLETE TWINE WRAP AROUND THE BALE. BELTS ARE DISENGAGED (4) AND TAILGATE RAISED. LOWER BELT EJECTS BALE (5) FROM BALE CHAMBER. IF BALE DOES NOT ROLL CLEAR OF TAILGATE, BALER PULLED FORWARD (6) UNTIL IT DOES. TAILGATE IS LOWERED (7) AND IDLER ARM TAKES UP SLACK IN UPPER BELTS. BELTS ARE ENGAGED, AND THE NEXT BALE STARTED (1).

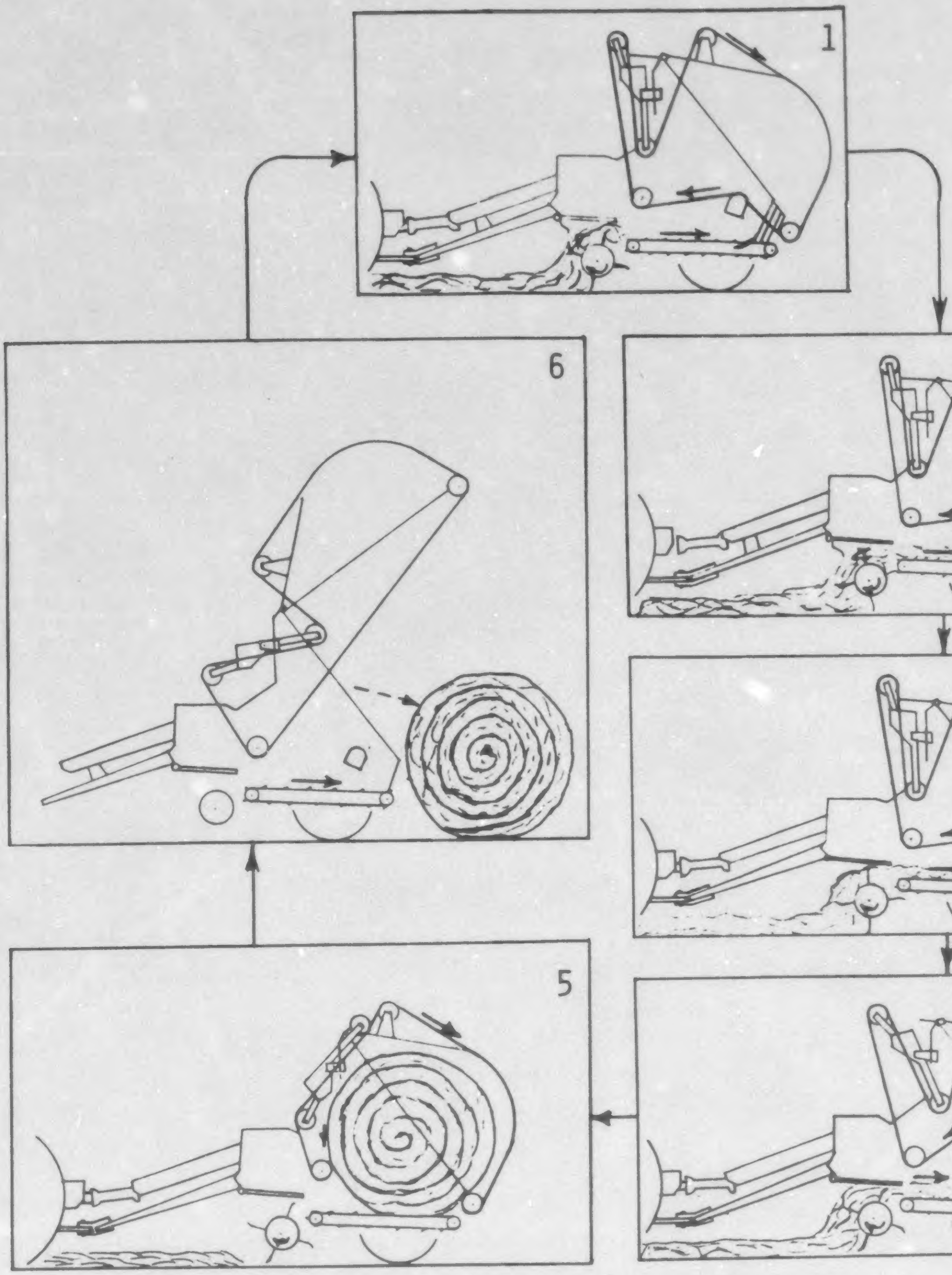

1
2
3
4
5
6
7
8
9
10
3-6 PRESSES
PER STACK
UNLOADING
STACKING

OPERATING CYCLES OF THE HESSTON STACKHAND 10

OPERATING CYCLES OF THE HESSTON STACKHAND 10

STACKING. HAY IS DELIVERED TO THE STACK CHAMBER (1, 2) WITH THE CANOPY IN THE UP POSITION. FORWARD TRAVEL IS STOPPED (3) WHEN THE CHAMBER IS FULL, SO THAT THE COMPRESSION CYCLE (4, 5, 6) MAY BE COMPLETED. MORE HAY IS DELIVERED (2) TO THE STACK CHAMBER.

UNLOADING. ON THE FINAL COMPRESSION (5), THE TAILGATE IS RAISED (7) AS THE CANOPY GOES UP. STACKER IS BACKED UP 25-30 FEET, THEN MOVED SLOWLY FORWARD WITH THE FLOOR CHAIN ENGAGED TO UNLOAD STACK (8). WHEN TAILGATE CLEARS STACK, CANOPY IS LOWERED UNTIL TAILGATE LATCHES (9). CANOPY IS RAISED TO THE UP POSITION (10) TO START NEW STACK (1).



OPERATING CYCLE OF THE NEW HOLLAND 850 ROUND BALER

OPERATING CYCLE OF THE NEW HOLLAND 850 ROUND BALER

HAY IS PICKED UP (1) AND DELIVERED TO THE FLOOR CHAIN ASSEMBLIES. WINDGUARD FINGERS KEEP HAY LOW AND FLAT. LUGS ON FLOOR CHAIN ASSEMBLIES MOVE HAY TO CURVED LEAF SPRINGS (2). HAY IS CURLED UPWARD TO MEET MAIN APRON CHAIN. ARROWS SHOW OPPOSING DIRECTION OF FLOOR CHAIN ASSEMBLIES AND MAIN APRON. TWO CAMS (3) (ARROW), ONE ON EACH SIDE OF THE CHAMBER, CONTROL PATH OF MAIN APRON CHAIN. THIS FORMS THE WEDGE-SHAPED CAVITY WHERE ROLLING ACTION BEGINS. THIS IS THE START OF UNIFORM BALE DENSITY. MAIN APRON CHAIN (4) CONTINUES TO ROLL HAY. LARGE COIL SPRINGS MAINTAIN PRESSURE ON MAIN APRON CHAIN ASSURING UNIFORM BALE DENSITY AS THE BALE GROWS. BIG, 5 1/2 FOOT DIAMETER BY 5 1/2 FOOT WIDE BALE (5) IS NOW FULLY FORMED. OPERATOR NOW WRAPS BALE WITHOUT LEAVING THE TRACTOR SEAT. OPERATOR EJECTS BALE (6) MECHANICALLY. WEIGHT OF BALE DEPRESSES CURVED LEAF SPRING. SPRINGS SNAP BACK INTO POSITION AGAIN, READY FOR ANOTHER BALE.

MANUFACTURER	MFG. RATED PACKAGE SIZE	CAPACITY TONS/HR †	ESTIMATED INVESTMENT AS OF SEPT. 1974 +	DENSITY IN BALES LBS/CU.FT.	MINIMUM TRACTOR
I. Vermeer					
a. 706A	3000 lb.Bale			10.8	60 HP.
b. 605B	1500 lb.Bale	8-10		10.5	45 HP.
II. Hawkbilt 480	1000 lb.Bale	8-10		6.1	35 HP.
II. Gehl Gehlbale 1500	1500 lb.Bale	8-12	$4595.00		50 HP.
IV. New Holland 850	1200 lb.Bale	8-12	$5265.00		50 HP.
V. International Big Roll 241	1500 lb.Bale		$5142.00		45 HP.
VI. Hesston					
a. Stackhand 60A	6 ton compressed stack			5.4	80 HP.
b. Stackhand 30	3 ton compressed stack	6-8		5.4	60 HP.
c. Stackhand 10	1½ ton compressed stack	2-3		5.6	40 HP.
VII. Haybuster Stack-EZE					
a. 1400	4 ton round stack			4.3	35 HP.
b. 1600	6 ton round stack			5.4	50 HP.
c. 1800	8 ton round stack			6[illegible]	50 HP.

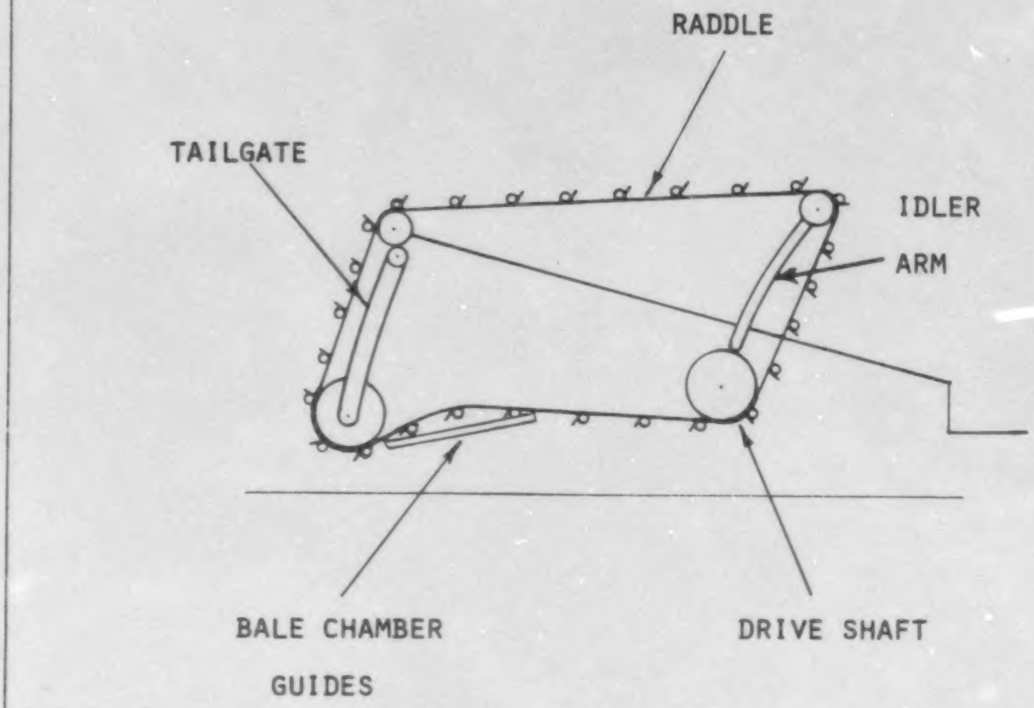
+ Based on 1972 Operating Data, OARDC and based on about 2 ton/acre hay, except Gehl used manufac
Where specifications are omitted we had no information.

+ Quoted by representatives at 1974 Farm Science Review.

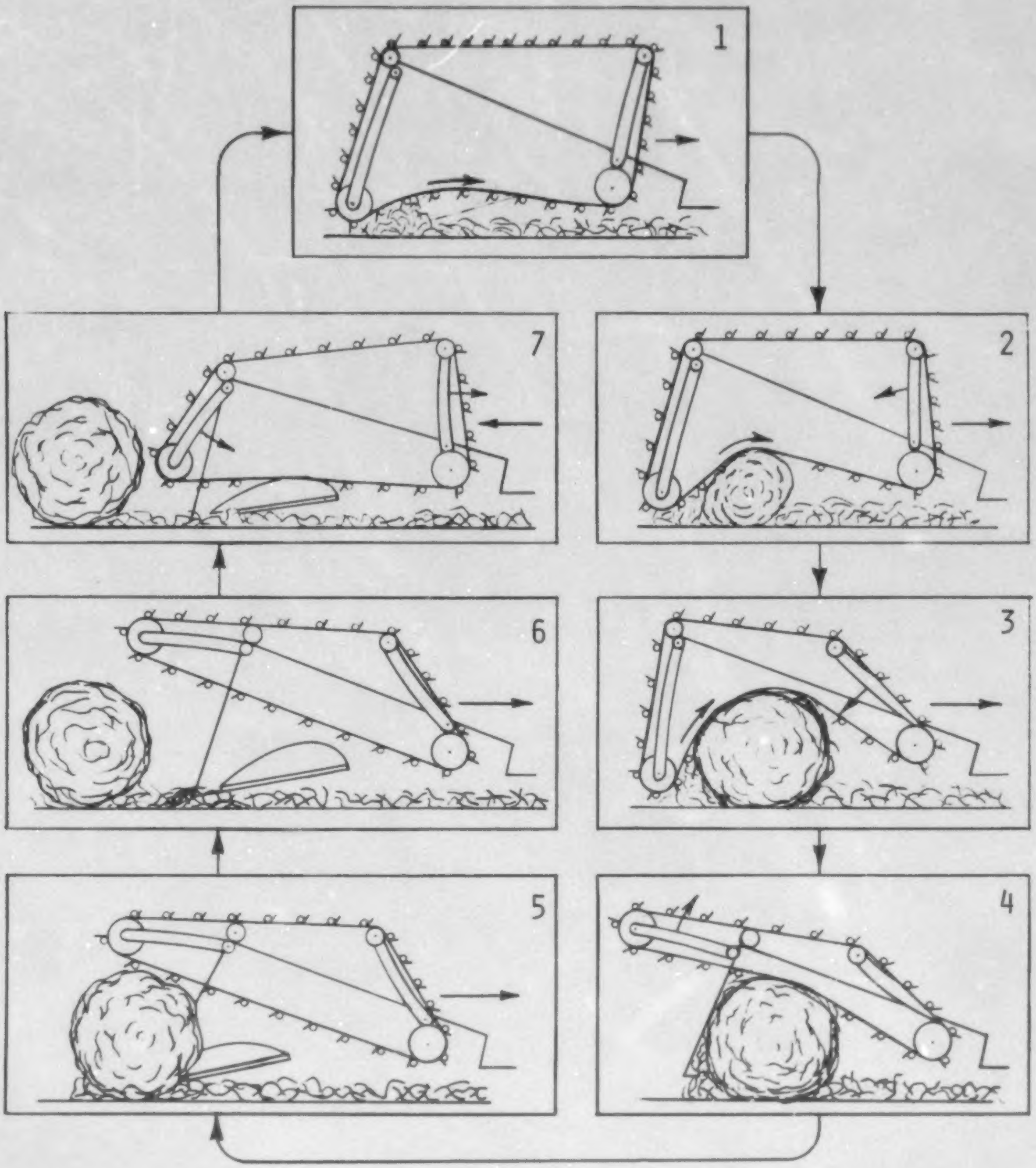
RATED E SIZE	CAPACITY TONS/HR †	ESTIMATED INVESTMENT AS OF SEPT. 1974 +	DENSITY IN BALES LBS/CU.FT.	MINIMUM TRACTOR	BPH-8 FEATURES
b.Bale			10.8	60 HP.	Spiral wound with twine.
b.Bale	8-10		10.5	45 HP.	Bale movers available.
b.Bale	8-10		6.1	35 HP.	Bale formed by rolling on ground, no twine.
b.Bale	8-12	$4595.00		50 HP.	Spiral wound with twine.
b.Bale	8-12	$5265.00		50 HP.	Chains instead of belts form bale. Spiral wound with twine.
b.Bale		$5142.00		45 HP.	Spiral wound with twine. Bale mover available.
com- d stack			5.4	80 HP.	Separate transporter unit available for each model. Feeder attachment available for 30 and 60A.
com- d stack	6-8		5.4	60 HP.	
com- d stack	2-3		5.6	40 HP.	
round ck			4.3	35 HP.	Rotating cage builds stack density.
round ck			5.4	50 HP.	
round ck			6.1	50 HP.	

g Data, OARDC and based on about 2 ton/acre hay, except Gehl used manufacturer's specifications.
re omitted we had no information.

ves at 1974 Farm Science Review.


RADDLE
TAILGATE
IDLER
ARM
BALE CHAMBER
GUIDES
DRIVE SHAFT

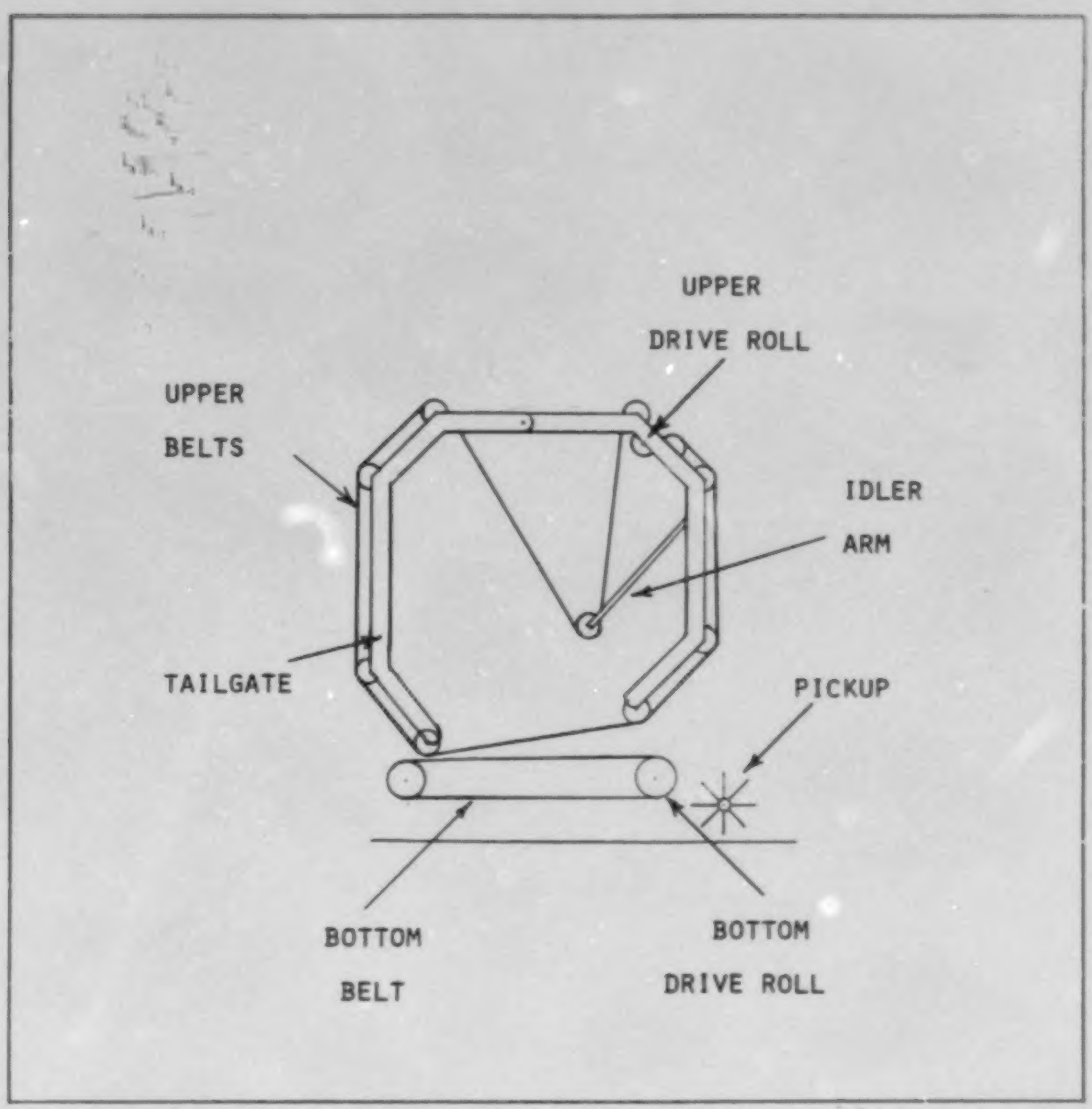
COMPONENTS OF HAWK BILT BALER



OPERATING CYCLE OF THE HAWK BILT BALER

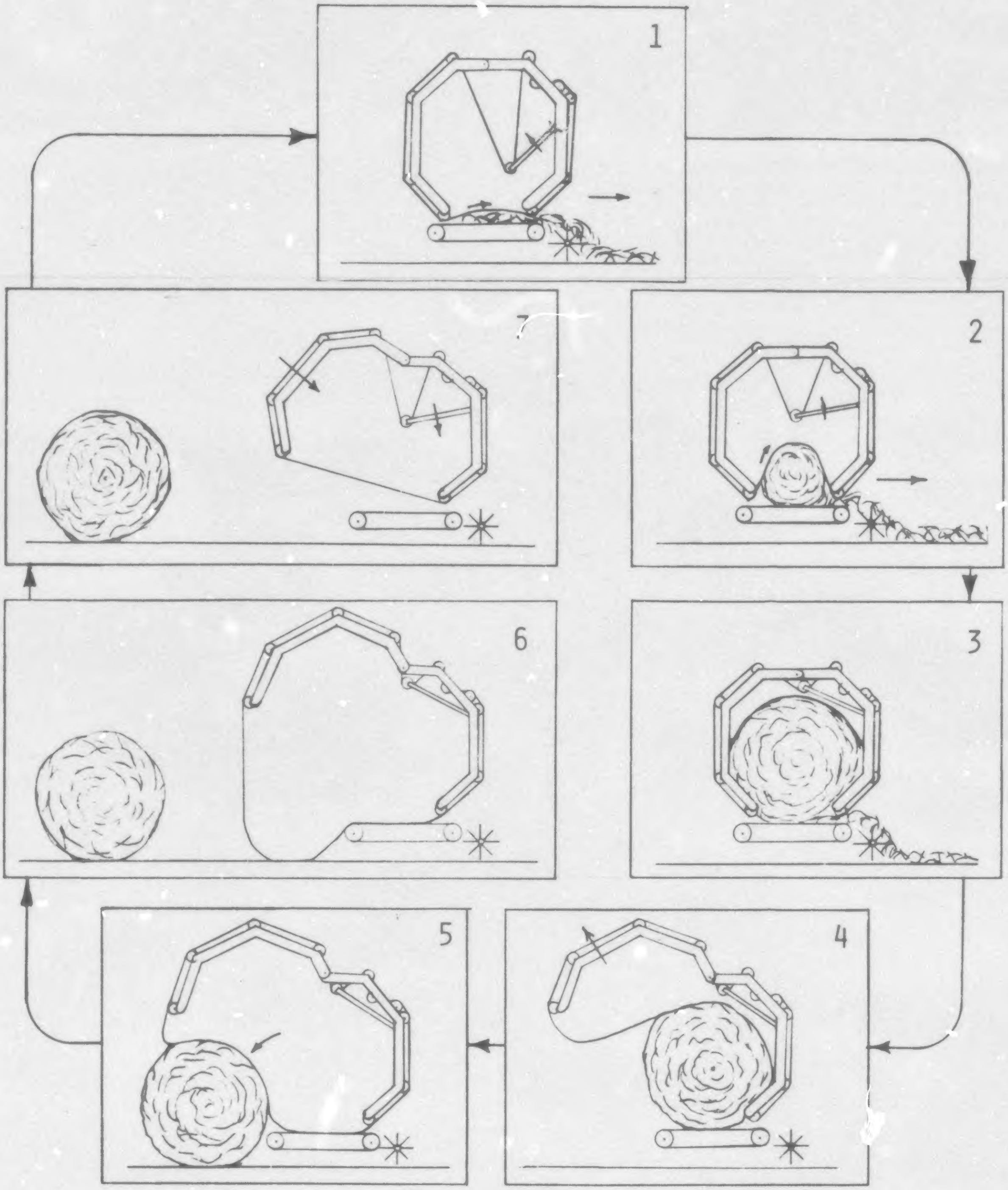
OPERATING CYCLE OF THE HAWK BILT BALER

BALE STARTS (1) WITH RADDLE ON BALE CHAMBER GUIDES, IDLER ARM IN FULL-FORWARD POSITION. IDLER ARM PIVOTS (2) AS BALE SIZE INCREASES. WHEN BALE IS FULL SIZE (3) IDLER ARM IS NEAR FULL-REAR POSITION. FORWARD TRAVEL IS STOPPED (4) AND TAILGATE RAISED, WHICH DISENGAGES RADDLE. RADDLE IS FREE TO ROTATE AS BALER IS PULLED CLEAR OF THE BALE (5, 6). TAILGATE IS LOWERED (7) AND BALER BACKED-UP TO GET HAY IMMEDIATELY IN FRONT OF THE BALE. RADDLE STARTS WHEN TAILGATE REACHES DOWN POSITION, AND THE NEXT BALE IS STARTED (1).


UPPER
DRIVE ROLL
UPPER
BELTS
IDLER
ARM
TAILGATE
PICKUP
BOTTOM
BELT
BOTTOM
DRIVE ROLL

COMPONENTS OF VERMEER BALERS

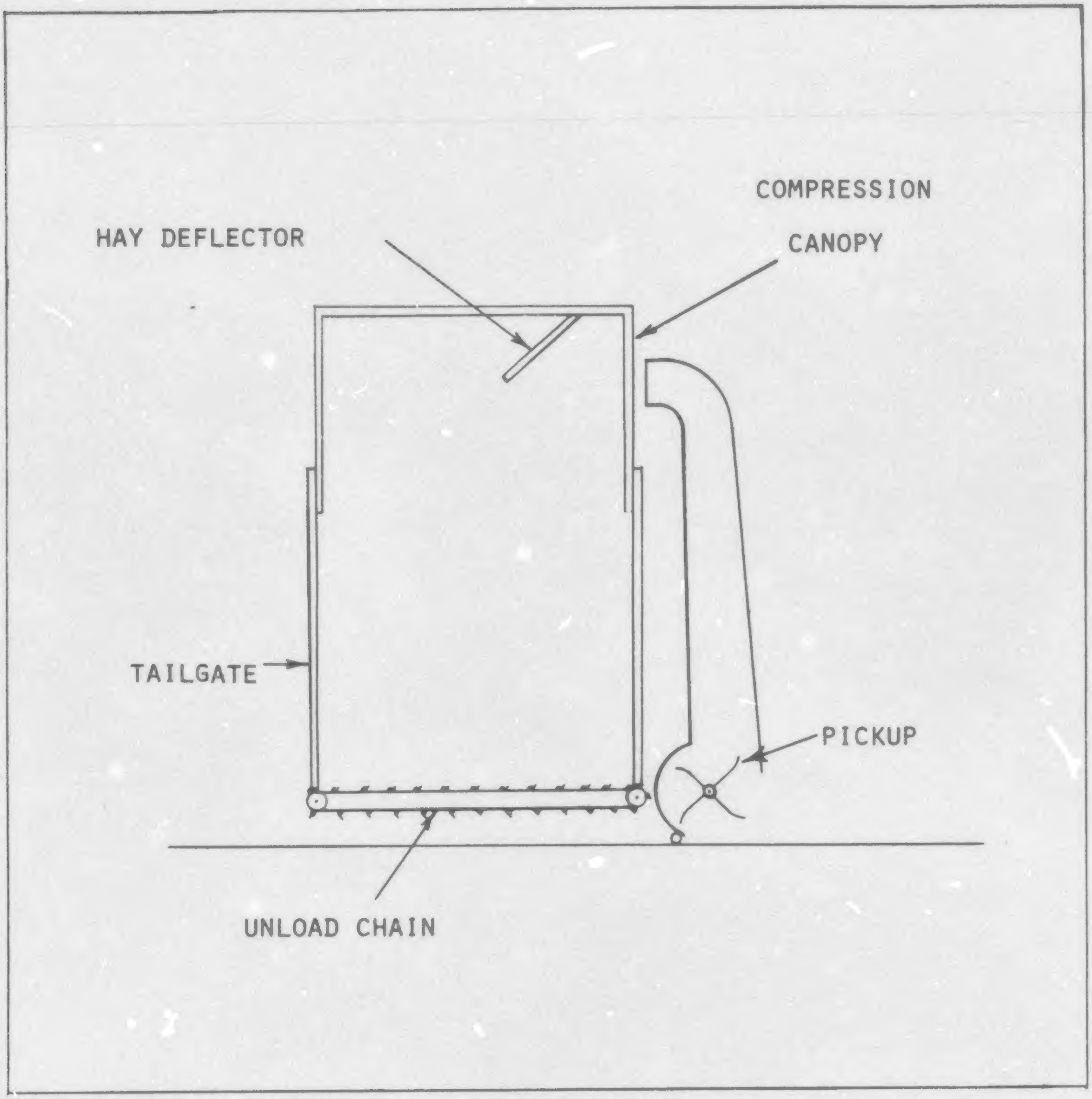
T 3



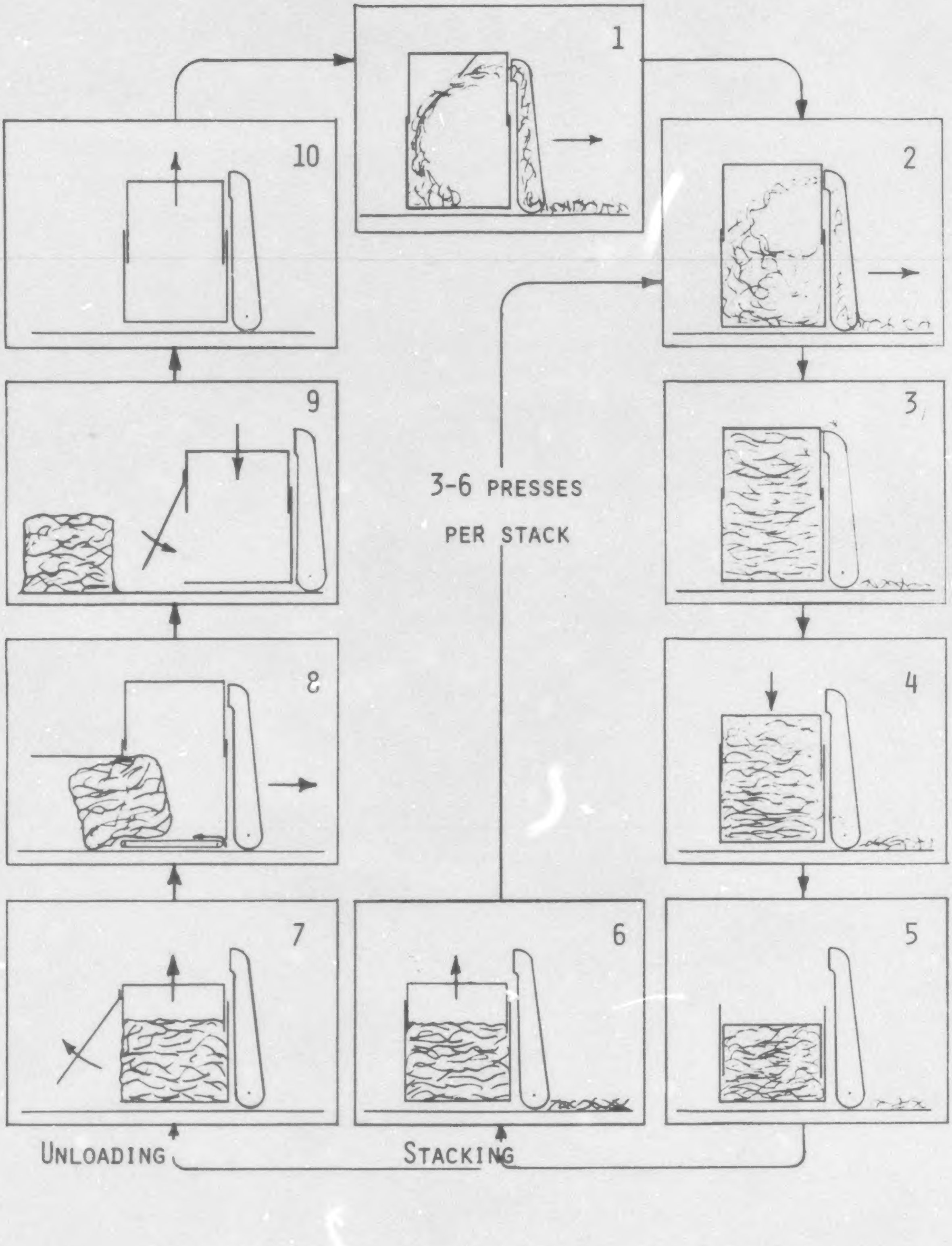
OPERATING CYCLE OF VERMEER BALERS

OPERATING CYCLE OF VERMEER BALERS

Bale starts (1) with idler arm in full-down position. Idler arm pivots (2) as bale size increases. As bale approaches full size (idler arm near full-up position), twine fed into outer bale layer, then forward travel stopped (3) to complete twine wrap around the bale. Belts are disengaged (4) and tailgate raised. Lower belt ejects bale (5) from bale chamber. If bale does not roll clear of tailgate, baler pulled forward (6) until it does. Tailgate is lowered (7) and idler arm takes up slack in upper belts. Belts are engaged, and the next bale started (1).


COMPRESSION CANOPY
HAY DEFLECTOR
TAILGATE
PICKUP
UNLOAD CHAIN

COMPONENTS OF HESSTON 10


1
2
3
4
5
6
7
8
9
10
3-6 PRESSES PER STACK
UNLOADING
STACKING

OPERATING CYCLES OF THE HESSTON STACKHAND 10

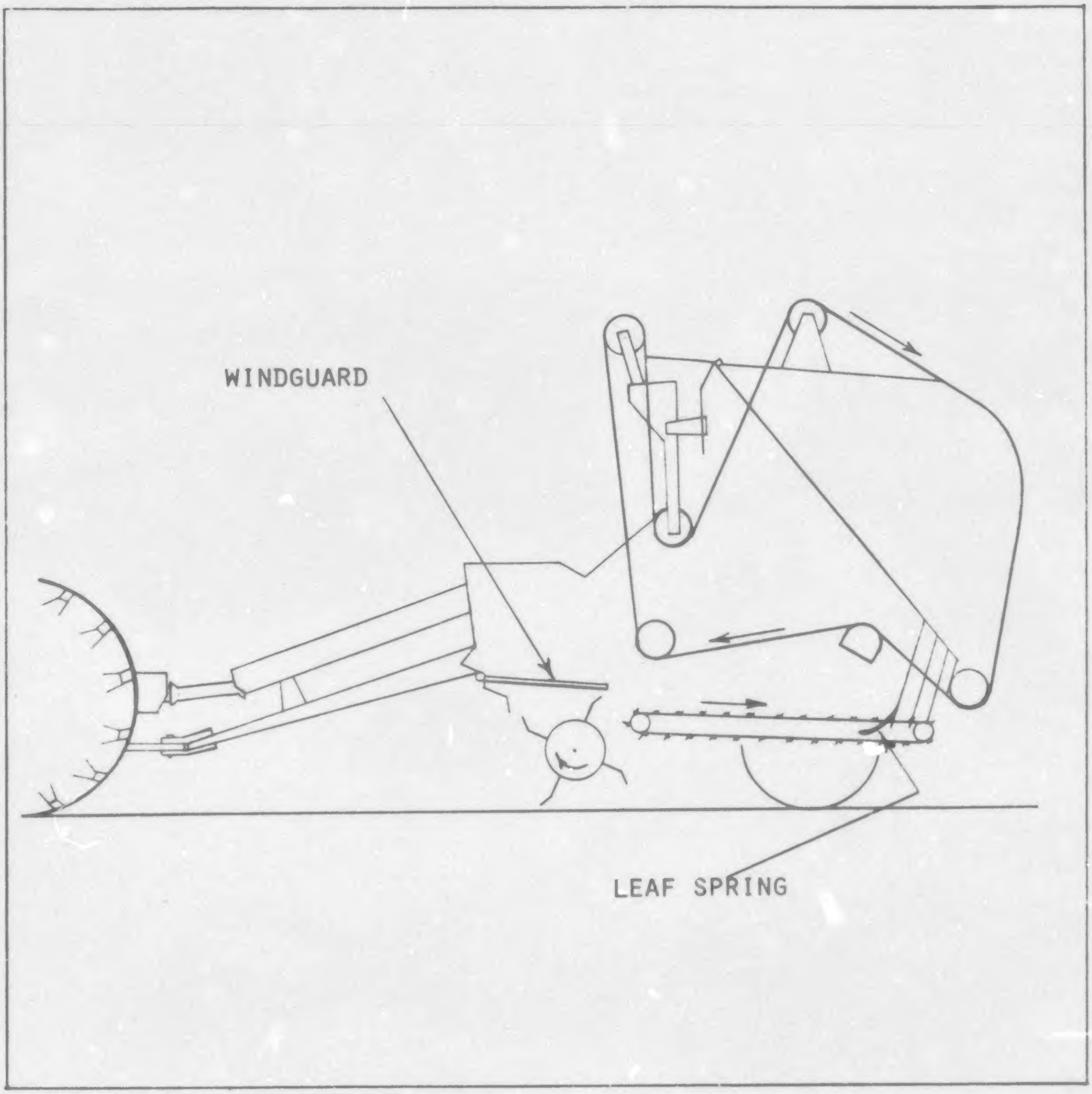
T 6

OPERATING CYCLES OF THE HESSTON STACKHAND 10

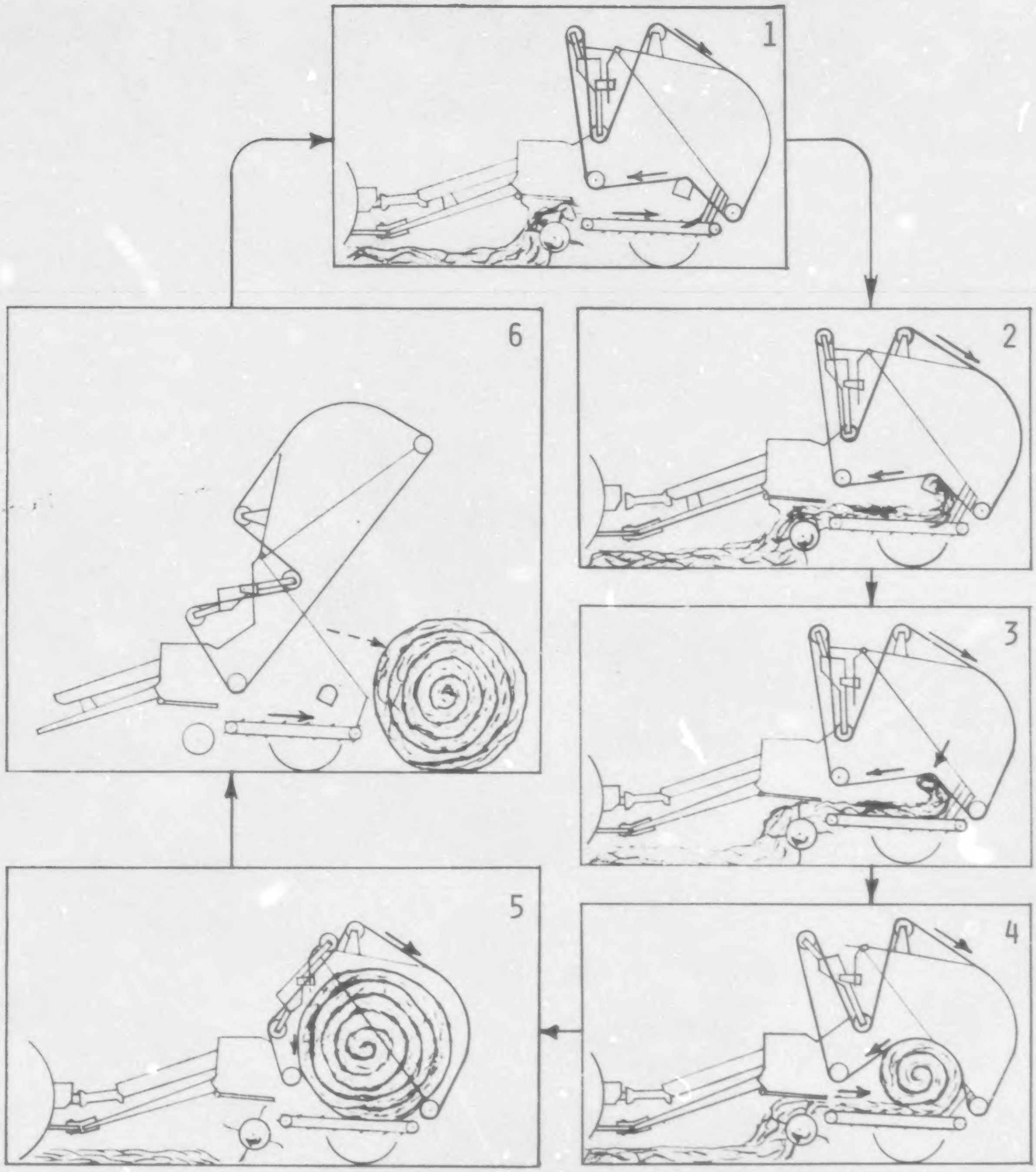
Stacking. Hay is delivered to the stack chamber (1, 2) with the canopy in the UP position. Forward travel is stopped (3) when the chamber is full, so that the compression cycle (4, 5, 6) may be completed. More hay is delivered (2) to the stack chamber.

Unloading. On the final compression (5), the tailgate is raised (7) as the canopy goes up. Stacker is backed up 25-30 feet, then moved slowly forward with the floor chain engaged to unload stack (8). When tailgate clears stack, canopy is lowered until tailgate latches (9). Canopy is raised to the UP position (10) to start new stack (1).

T 6


WINDGUARD
LEAF SPRING

COMPONENTS OF NEW HOLLAND 850 ROUND BALER



OPERATING CYCLE OF THE NEW HOLLAND 850 ROUND BALER

OPERATING CYCLE OF THE NEW HOLLAND 850 ROUND BALER

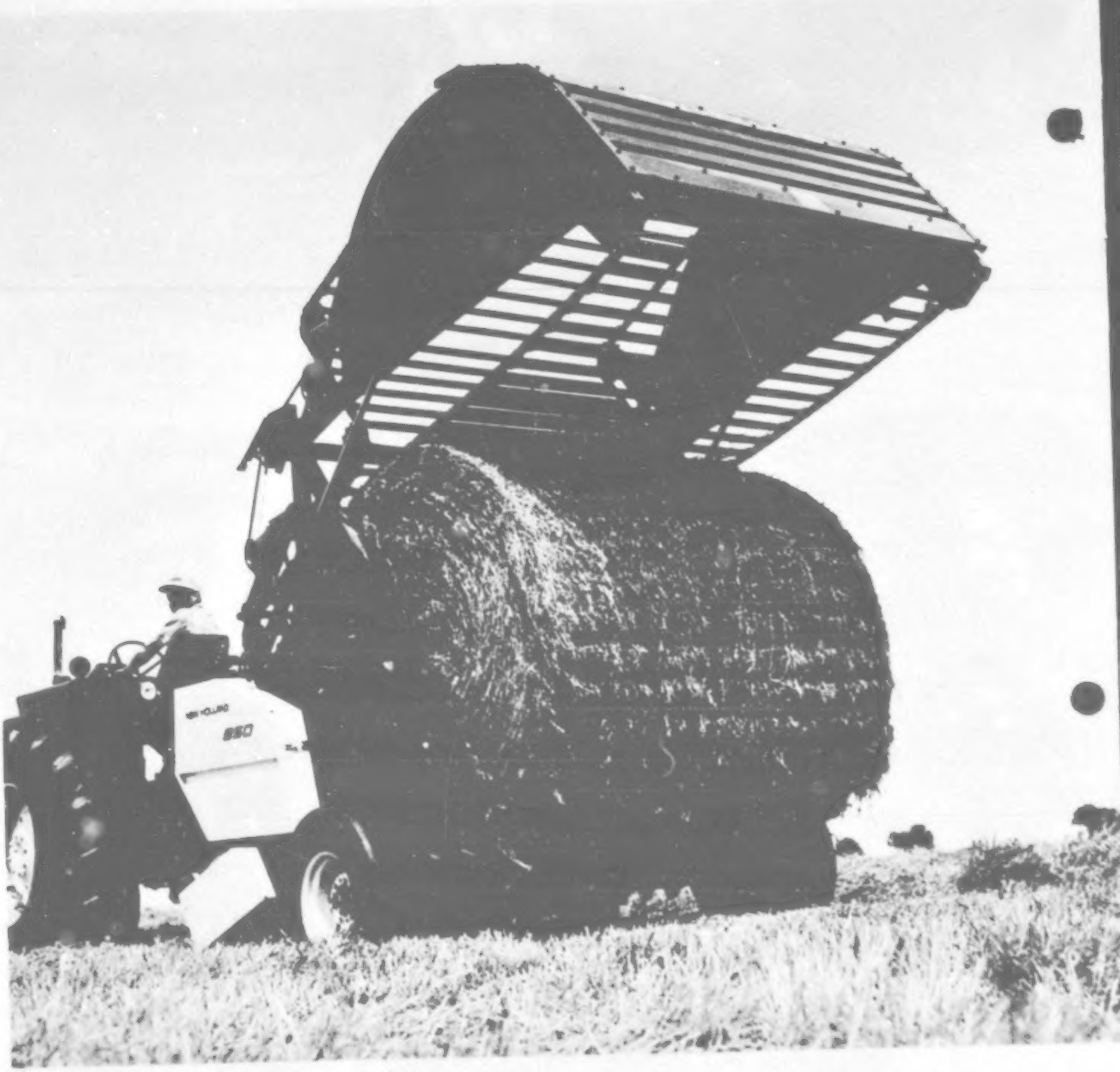
HAY IS PICKED UP (1) AND DELIVERED TO THE FLOOR CHAIN ASSEMBLIES. WINDGUARD FINGERS KEEP HAY LOW AND FLAT. LUGS ON FLOOR CHAIN ASSEMBLIES MOVE HAY TO CURVED LEAF SPRINGS (2). HAY IS CURLED UPWARD TO MEET MAIN APRON CHAIN. ARROWS SHOW OPPOSING DIRECTION OF FLOOR CHAIN ASSEMBLIES AND MAIN APRON. TWO CAMS (3) (ARROW), ONE ON EACH SIDE OF THE CHAMBER, CONTROL PATH OF MAIN APRON CHAIN. THIS FORMS THE WEDGE-SHAPED CAVITY WHERE ROLLING ACTION BEGINS. THIS IS THE START OF UNIFORM BALE DENSITY. MAIN APRON CHAIN (4) CONTINUES TO ROLL HAY. LARGE COIL SPRINGS MAINTAIN PRESSURE ON MAIN APRON CHAIN ASSURING UNIFORM BALE DENSITY AS THE BALE GROWS. BIG, 5 1/2 FOOT DIAMETER BY 5 1/2 FOOT WIDE BALE (5) IS NOW FULLY FORMED. OPERATOR NOW WRAPS BALE WITHOUT LEAVING THE TRACTOR SEAT. OPERATOR EJECTS BALE (6) MECHANICALLY. WEIGHT OF BALE DEPRESSES CURVED LEAF SPRING. SPRINGS SNAP BACK INTO POSITION AGAIN, READY FOR ANOTHER BALE.

ROUND BALER

Model 850

SPERRY NEW HOLLAND

NEW HOLLAND
850



Here's the fast one-man way to make hay that requires no indoor storage. You save valuable time and labor normally required for transporting and storing your hay crop indoors.

Conveyor chains, *not belts*, form the bale *inside* the "850"—not along the ground. This reduces field loss and provides clean hay. Rolling action and an exclusive adjustable twine tension control produce a tight, thatch-like weather-resistant surface. And, the "850" makes 12 to 20 bales an hour depending on crop and field conditions.

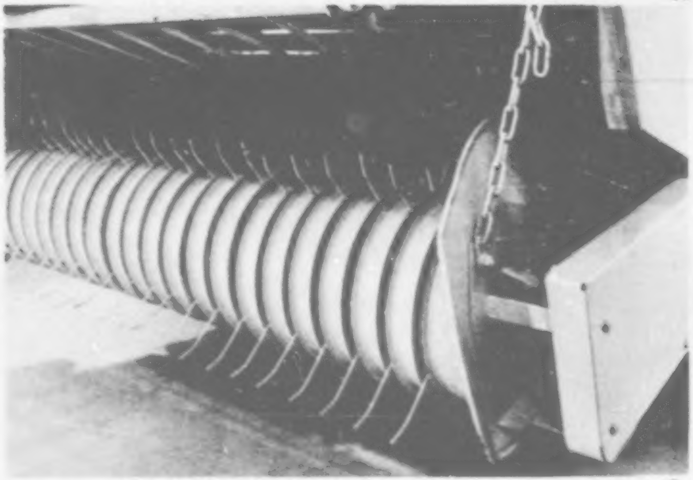
Dependability and ease of operation were designed into the Sperry New Holland Round Baler. Extensive field testing in a variety of crops and conditions prove its reliable performance. Much of this testing was done by lending test machines to farmers. These "new" operators required no special training to operate this uncomplicated machine.

© 1974 SPERRY NEW 188 A DIVISION OF SPERRY RAND CORPORATION, NEW HOLLAND, PENNA.

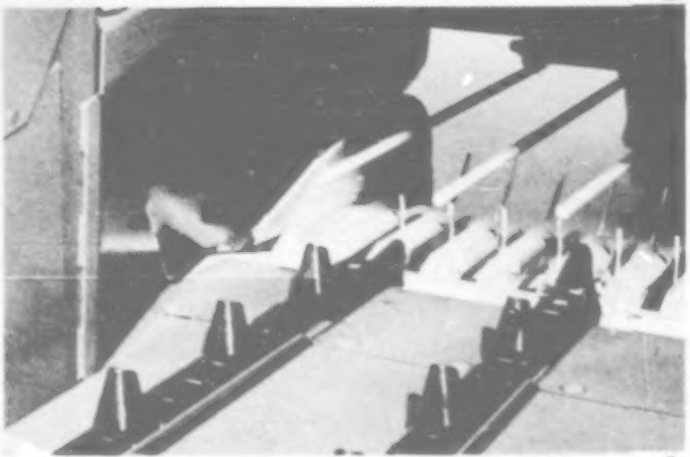
Exclusive features provide uniform b

1. **Super-Sweep pickup** is 72″ wide with flared side plates. Pickup follows wide windrows and fills out the ends of the bale. Windguard is standard.
2. **Tapered bale chamber** funnels the layer of hay making sharp-edged ends for better bale shape, better weathering.
3. **Floor chain assemblies, with lugs,** deliver hay to curved leaf springs.
4. **Main apron chains** begin the rolling action that forms the core. See drawing B.

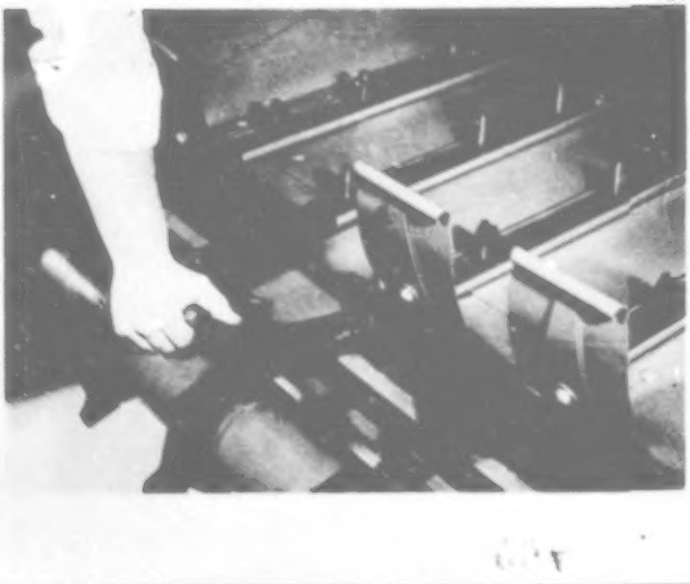
1.



2.



3.



4.

NEW HOLLAND

ale density for better weathering.

5. **Cams form the wedged-shaped cavity** inside the chamber. This forms the core of the bale quickly. See drawing C.

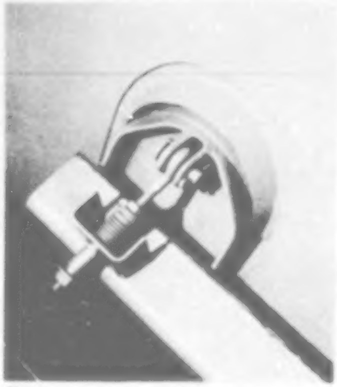
6. **Core density breakaway latch** releases automatically after bale is started and core density is established.

7. **Heavy-duty coil springs** maintain tension on the main apron chain for uniform density. Bale density is adjustable for various crops and conditions.

8. **Adjustable twine tension** allows operator to wrap bale firmly. The spiral wrapping holds without a knot.

9. **Main apron de-clutches automatically** for bale ejection. It takes about four minutes to make, wrap and eject a bale . . . all without leaving the tractor seat.

5.



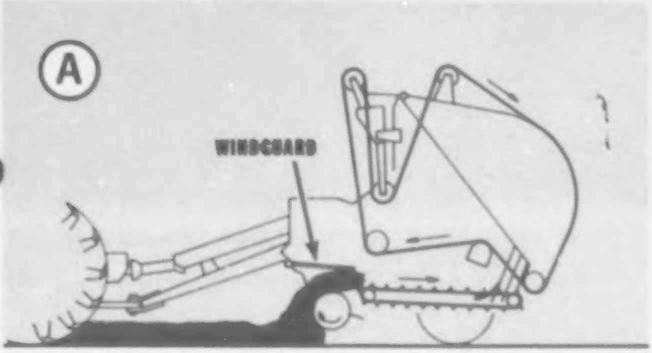
6.

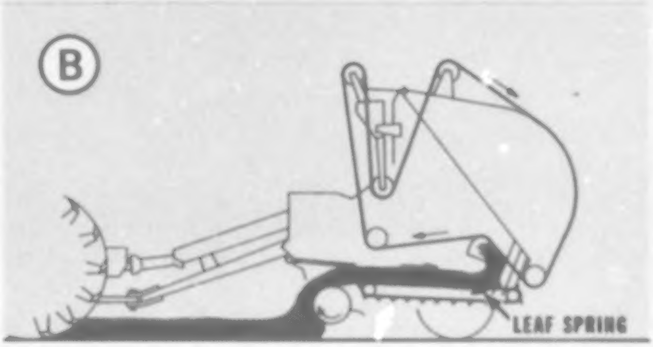
7.

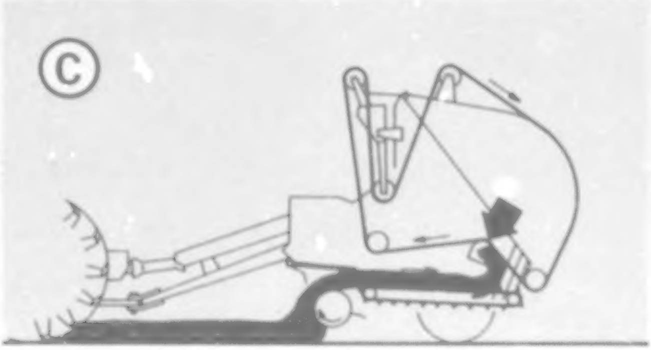
9.

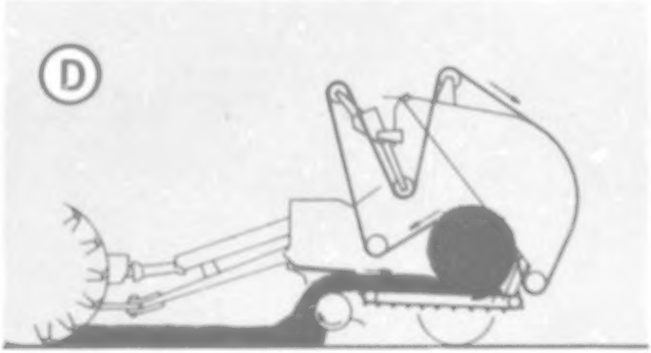
8.

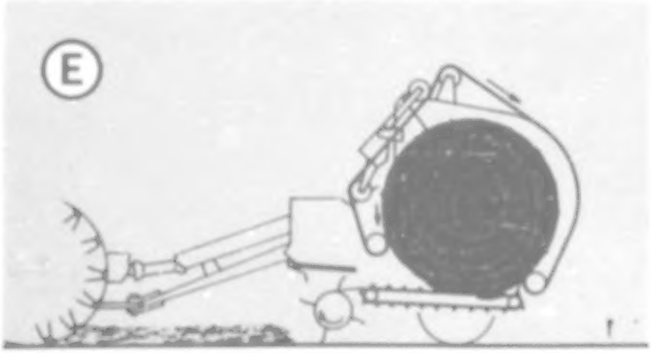
NEW HOLLAND
850











Here's how the "850" works!

A. Hay is picked up and delivered to the floor chain assemblies. Windguard fingers keep hay low and flat.

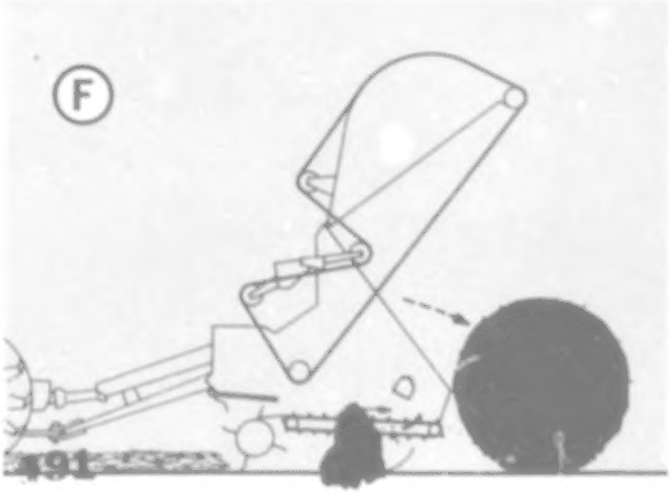
B. Lugs on floor chain assemblies move hay to curved leaf springs. Hay is curled upward to meet main apron chain. Arrows show opposing direction of floor chain assemblies and main apron.

C. Two cams (arrow), one on each side of the chamber, control path of main apron chain. This forms the wedge-shaped cavity where rolling action begins. This is the start of uniform bale density.

D. Main apron chain continues to roll hay. Large coil springs maintain pressure on main apron chain assuring uniform bale density as the bale grows.

E. Big, 5½ ft diameter by 5½ ft wide bale is now fully formed. Operator now wraps bale without leaving the tractor seat.

F. Operator ejects bale mechanically. Weight of bale depresses curved leaf spring. Springs snap back into position again, ready for another bale.



The fast one-man way to make hay. No indoor storage needed . . . weather-resistant bales stay in the field for future feeding.

MODEL 850 ROUND BALER SPECIFICATIONS

Length	153"
Width	95"
Height	101"
Bale size	5½' diameter x 5½' long
Bale weight	900 to 1,500 pounds
Capacity	8–12 tons per hour
Power	50 HP or more at tractor PTO
Crops	Fescue, timothy, orchard grass, alfalfa, prairie hay, Bermuda, corn stalks, straw, soybean residue, sudan and others.
Twine	Sisal or Plastic or Binder twine. Requires 100–200 ft. per bale.
Drive	540 RPM, PTO only 90° bevel box Shearbolt protected Floor chain assemblies drive: #80 chain Main apron drive: Double "HB" V-belt Slip clutch protected pickup drive
Pickup	Wide, 72" Super-Sweep pickup with 104 teeth
Main apron	Welded steel slat-chain construction
Floor chain assemblies	Eight gathering-type steel chains

Sperry New Holland reserves the right to change its products and their specifications at any time without notice or obligation.

The word New Holland is a registered trademark of the Sperry Rand Corporation. Sperry New Holland is an additional trademark of the Sperry Rand Corporation.

Farm-Engineered Machinery by Sperry New Holland: Balers • Bale Throwers • Round Balers • Mowers • Rakes • Mower-Conditioners • Windrowers • Automatic Bale Wagons • Stack Retrievers • Bale Elevators/Conveyors • Combines • Grinder-Mixers • Forage Harvesters • Forage Blowers • Forage Boxes • Manure Spreaders • Farm Wagons • Baler Twine and Wire

SPERRY NEW HOLLAND

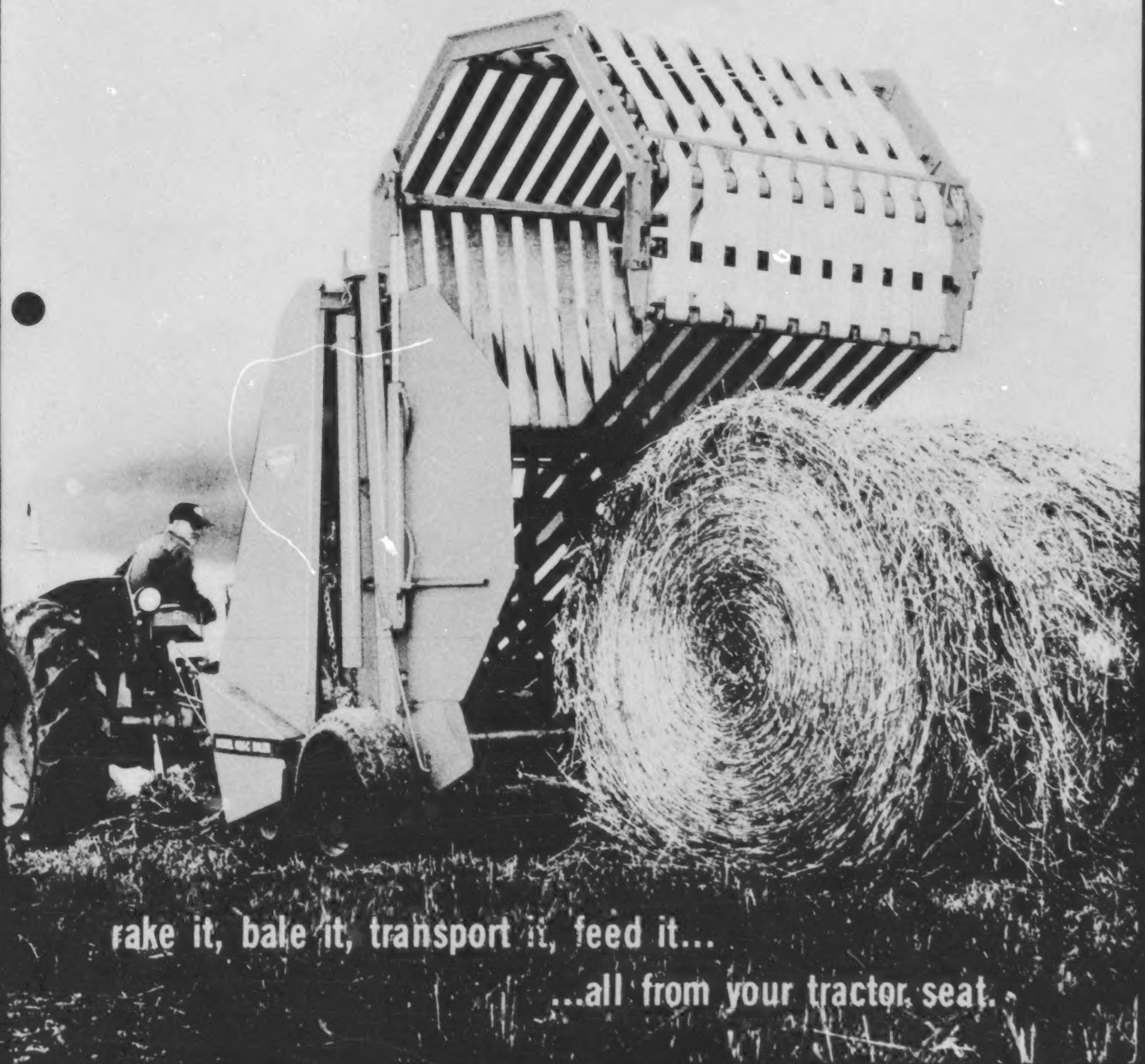
NEW HOLLAND

ALWAYS INSIST ON TOP-QUALITY NEW HOLLAND TWINE!

31085010-7-74 COX

VERMEER

Vermeer One Man Hay System

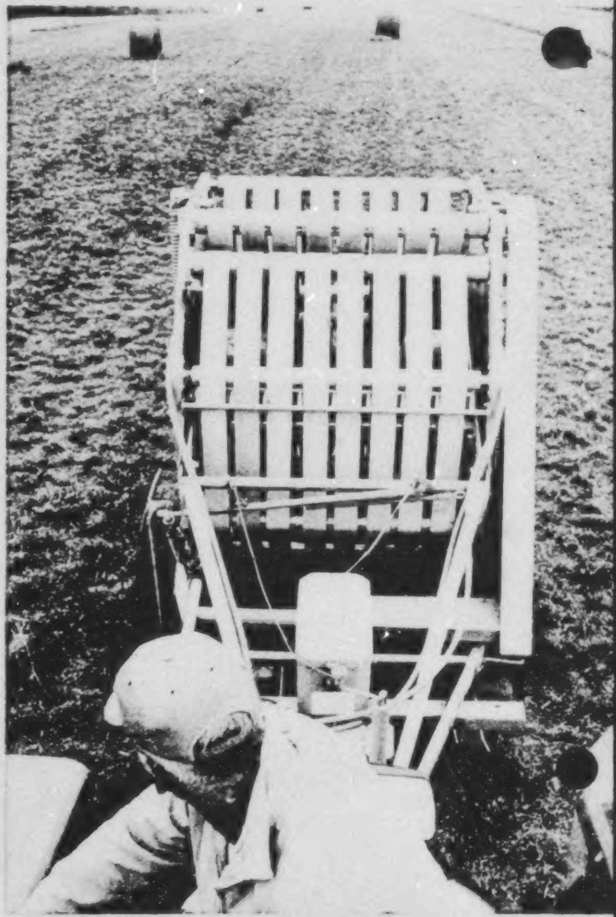


rake it, bale it, transport it, feed it...

...all from your tractor seat.

At last ... the end of lifting, loading, unloading, stacking, and storing hay bales with the

VERMEER ONE MAN HAY SYSTEM



Here's the one you've read about--the haying system that eliminates the hard work in haymaking. The Vermeer One-Man Hay System. Owned by thousands of farmers throughout the United States and Canada and operated in all types of hay crops and conditions, these Vermeer machines have made the dream of one-man hay harvesting a reality! Now you can rake it, bale it, transport it, and feed it-- all from your tractor seat. Use the Vermeer R-21A Twinrake to cut your raking time by two-thirds. Then team it up with the Vermeer Baler best suited to your farming operation... the Model 504C, 605C, or 706C. Vermeer Balers make round twine-wrapped bales from 4 to 6 feet wide and from 5 to 7 feet in diameter, depending on the model you choose. These big tightly-packed bales are weather-resistant so you can leave them outside if you wish and waste is kept at a minimum. Although simple in design, these Vermeer machines have the rugged industrial-type construction needed to provide dependable service. Compare capacity, compare speed, compare cost. The Vermeer One-Man Hay System in your operation can save labor, save time, and save money.

VERMEER Offers All These Important Advantages

ONE-MAN OPERATION

The Vermeer One-Man Hay System reduces the old hay crew to one man. No need for hired labor in the field or at the barn...it lets you bale when your hay is ready.

LOWER INVESTMENT

Compare the cost of the Vermeer system with any other hay-handling system and see for yourself the savings you can realize on equipment costs.

HIGH CAPACITY

The speed and capacity of the Vermeer system means you can harvest more hay per day than with any other method. Get that extra jump on the weather which can be so important.

DEPENDABLE EQUIPMENT

These Vermeer machines, designed for agricultural use, built like industrial equipment, are constructed of the finest materials available, giving you the dependability you have come to expect from Vermeer.

CHOICE OF BALER MODELS

Choose the model best suited to your farming operation... the 504C (4 ft. x 5 ft.); the 605C (5 ft. x 6 ft.); or the 706C (6 ft. x 7 ft.). Bales vary in weight from 800 lbs. to 3000 lbs.

VERMEER BALES

The Vermeer Baler lets you choose a soft-core or high-density large round bale. Both types handle hay gently, preserve the entire hay plant for greater palatability, higher nutrition.

YEARS OF EXPERIENCE

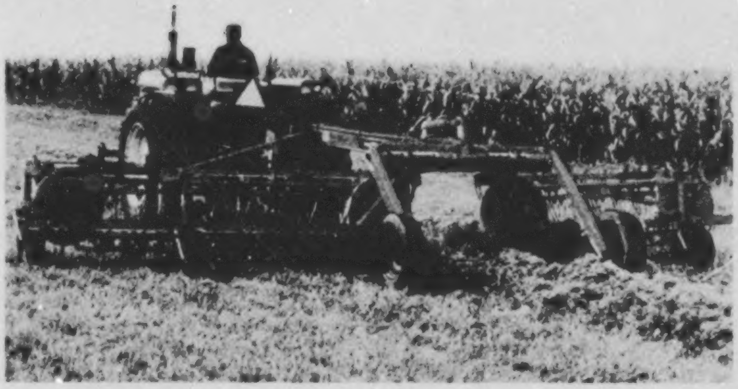
Choose the one-man hay system with a proven track record. Years of experimenting and development means you get the most advanced design with prov[illegible] dependability and ease of operation.

PROVEN RECORD

Thousands of farmers throughout the United States and Canada can't be wrong. Surveys indicate nearly 97% of all Vermeer Baler owners would buy Vermeer again!

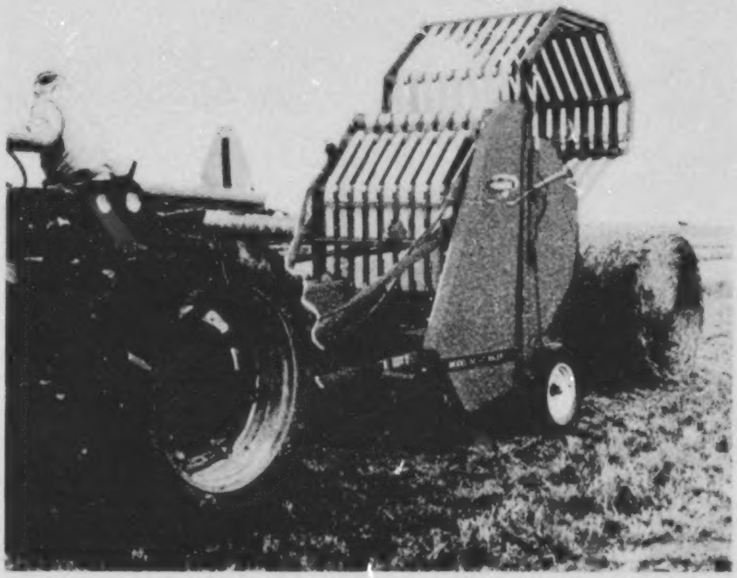
R-21A TWINRAKE

Time means money during hay harvesting. The Vermeer R-21A Twinrake is just what you've been looking for. Cut your raking time as much as two-thirds. Windrow width can be adjusted from 3 ft. to a big 6-ft. wide twin windrow. Smooth hydraulic drive lets you vary your raking speed in relation to your ground speed. You don't need an extra hydraulic pump--the Twinrake operates directly from your tractor's hydraulic system. In the field, it's adjustable-- raking from 12 to 21 ft. wide and when you want to transport, the Twinrake folds to a narrow 94 inches, well within road limits.

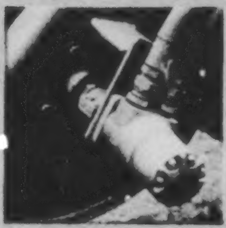


504C BALER

The newest member of the Vermeer Baler family, this little big baler is designed for efficient operation behind a 35-horsepower tractor. The 504C allows even a smaller operation to take advantage of the Vermeer One-Man Hay System. The tightly-packed bales from the Model 504C usually weigh 800 to 1000 lbs. The 4-ft. wide package allows a maximum payload for shipping large round bales on 8-ft. wide trucks. Ideal for use in modern dairy operations.

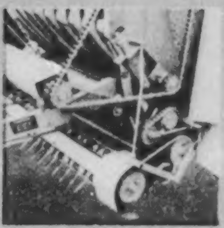


Twinrake Folds To 94" wide for transport. Equipped with high-speed wheel bearings for highway towing.



Industrial Grade Hydraulic Motors deliver smooth, variable speed drive for positive raking action.

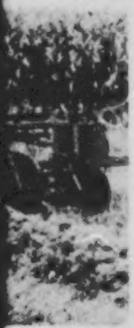
Torque Limiter protects drive train against damage caused by foreign objects and overloading.



Simple, Dependable Drive System delivers constant power to the drive rollers and pickup.

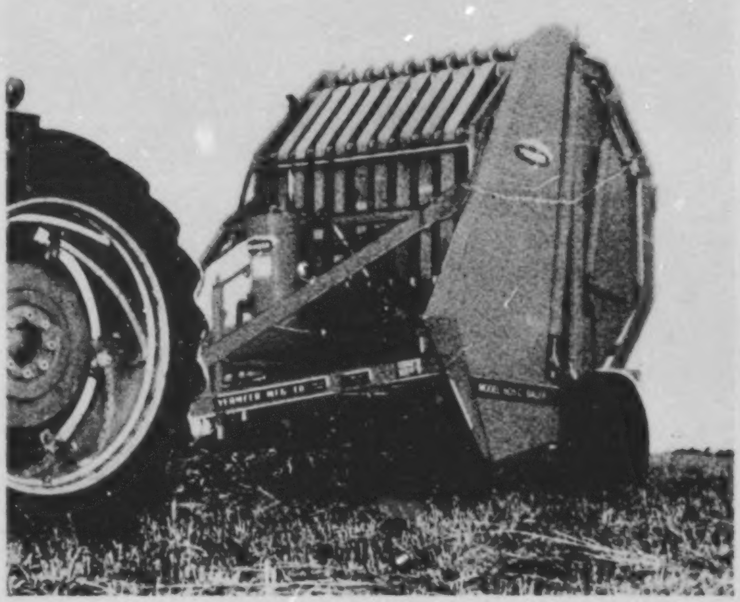
Standard Bearings, Sprockets and Chains are utilized throughout the machines.

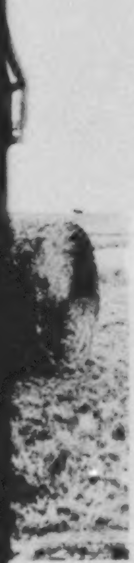
New, Impr
up desig
complete fie
and positi
action.



605C BALER

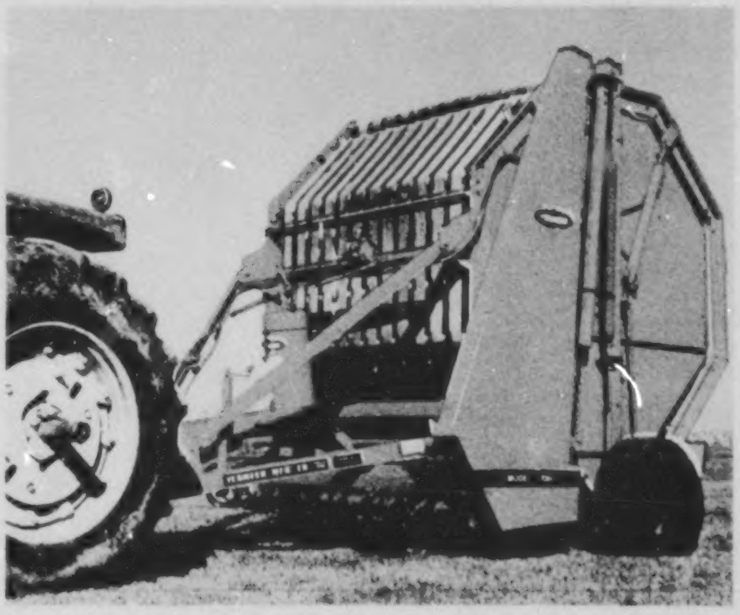
The most popular of the Vermeer Baler family! Most operators report harvesting 10-15 tons per hour! Bales from the Model 605C usually weigh 1200-1500 lbs. This baler operates efficiently when coupled with 45-70 horsepower tractors. Choose from soft-core or high-density options. Expensive platform belts have been eliminated from all Vermeer Balers, giving you reduced leaf loss, increased speed of operation and fewer expensive repairs.



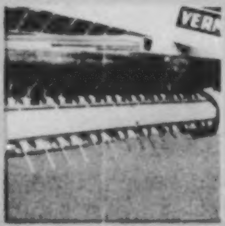


706C BALER

The big one! Put three times as much hay in a single bale as with the 504C. More hay in one package means less hay exposed to weather, fewer trips to the storage area, fewer trips to your feeding area. Designed to operate with a 60-100 horsepower tractor. Bales from the 706C usually weigh 2500-3000 lbs. If you're interested in high-capacity (up to 20 tons per hour), the 706C is designed for you.



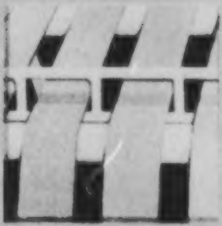
earings,
Chains
hrough-
nes.



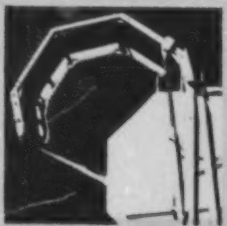
New, Improved Pick-up design means complete field cleanup and positive, gentle action.

Positive Drive Platform Rollers provide gentle handling of hay. Close tolerance practically eliminates leaf loss.

Spring Belt Tension produces tightly compacted bales, giving immediate weather-resistant characteristics.



Belt Guides extend belt life by keeping them aligned--no twisting or tangling.



Hydraulic Bale Ejector allows operator to drop bale at any size from 2½ ft. diameter to maximum.

ermeer One-Man Hay System
PECIFICATIONS

R-21A Twinrake
Weight: 2360 lbs. (1069 kg)
Length: 234'' (594 cm)
Width - operation: 288'' (732 cm)
- transport: 94'' (239 cm)
Height - operation: 57'' (145 cm)
- transport: 62'' (157 cm)
Tire size - front: 5.70 x 5.00-8, 4-ply
- rear: 7.75 x 14, 4-ply
Windrow width: Variable 3-6 ft. (91-183 cm)
Teeth: Rubber mounted

504C Baler
Weight: 3090 lbs. (1400 kg)
Length: 152'' (386 cm)
Width: 81'' (206 cm)
Height: 94'' (239 cm)
Hitch weight: 600 lbs. (272 kg)
Tire size: E78-14, 8-ply
Drive: PTO with roller chain
Bale diameter - minimum: 2½ ft. (76 cm)
- maximum: 5 ft. (152 cm)
Bale width: 4 ft. (122 cm)
Minimum tractor requirement: 35 hp

605C Baler
Weight: 4360 lbs. (1975 kg)
Length: 168'' (427 cm)
Width: 89'' (226 cm)
Height: 106'' (269 cm)
Hitch weight: 645 lbs. (292 kg)
Tires - standard: 7.00 x 15, 8-ply
- optional: 10.00 x 16.5, 6-ply
Drive: PTO with roller chain
Bale diameter - minimum: 2½ ft. (76 cm)
- maximum: 6 ft. (183 cm)
Bale width: 5 ft. (152 cm)
Minimum tractor requirement: 45 hp, 3 plow

706C Baler
Weight: 5440 lbs. (2464 kg)
Length: 183'' (465 cm)
Width: 112'' (284 cm)
Height: 124'' (315 cm)
Hitch weight: 870 lbs. (394 kg)
Tires: 12.00 x 16.5, 8-ply
Drive: PTO with roller chain
Bale diameter - minimum: 2½ ft. (76 cm)
- maximum: 7 ft. (213 cm)
Bale width: 6 ft. (183 cm)
Minimum tractor requirement: 60 hp, 4 plow

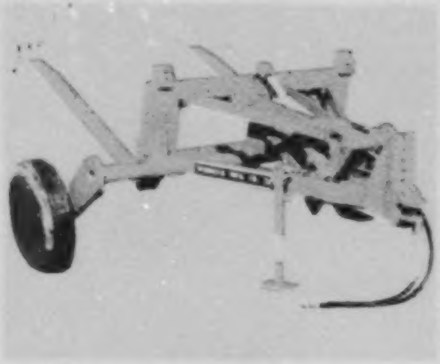
2W Bale Carrier
Weight, less tires: 1362 lbs. (617 kg)
Length: 140'' (356 cm)
Width: 96'' (244 cm)
Height - lowered position: 30'' (76 cm)
- raised position: 50'' (127 cm)
Length of forks: 72'' (183 cm)
Maximum spread of forks: 54'' (137 cm)
Wheel rims: Standard 14''
Hitch height adjustment: 10'' (25 cm)

Economy Bale Carrier
Weight: 280 lbs. (127 kg)
Length: 69'' (175 cm)
Width: 37'' (94 cm)
Height: 13'' (33 cm)
Length of forks: 55'' (140 cm)
Spread of forks: 34'' (86 cm)
Hitch: 3-point, category 2 or IH ''fast hitch''
Minimum tractor requirement: 4 plow
Usual Warranty Does Not Apply.

Bale Carrier / Unroller
Weight: 420 lbs. (190 kg)
Length: 52'' (132 cm)
Width - minimum: 77'' (196 cm)
- maximum: 121'' (307 cm)
Height: 34'' (86 cm)
Spread of points - minimum: 26'' (66 cm)
- maximum: 70'' (178 cm)
Hitch: 3-point, category 2
Minimum tractor requirement: 4 plow

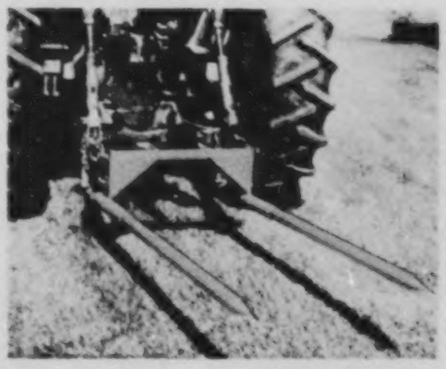
Bale Wagon
Weight: 3460 lbs. (1567 kg)
Length: 384'' (975 cm)
Width: 83'' (211 cm)
Height: 99'' (251 cm)
Deck height: 31'' (79 cm)
Capacity: Five 504C or 605C bales
Tires: 12.00 x 16.5, 8-ply
Controls: Hydraulic

Transporting, Storin



MODEL 2W CARRIER

Even your smaller farm tractor can be used to move the largest Vermeer bales. The lifting mechanism ''cradles'' the bale in transport. The hitch adjusts for different drawbar heights. It can also adapt for use with a pickup truck.

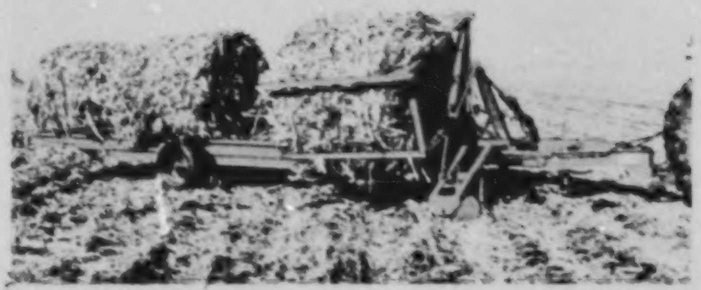


ECONOMY CARRIER

This inexpensive carrier is designed to carry bales made by the Model 605 only. It attaches quickly and easily to any standard Category 2 three-point hitch. (Also available to fit IH ''fast hitch'').

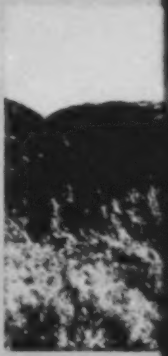
BALE CARRIER/ UNROLLER

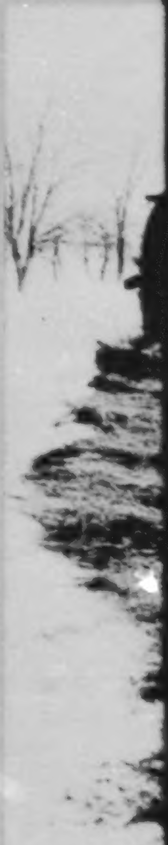
Designed for use as a bale carrier during hay harvest season, this attachment also serves as a bale unroller, laying down a blanket of hay for convenient wintertime feeding. The unit fits any standard Category 2 three-point hitch.



BALE WAGON

New for 1975! The Vermeer Bale Wagon lets you move up to five 504C or 605C Vermeer Bales at a time. Your tractor's two-way hydraulic system loads, unloads....quickly, efficiently. The Bale Wagon unloads bales in the same position every time, eliminating possible weather damage caused by setting bales upside down.





Vermeer Manufacturing Company re
changes in engineering, design, and sp
ments, or discontinue manufactur
notice or obligation.

, Storing, And Feeding Are Simplified

Round Vermeer bales may be stored outdoors, eliminating the need for hay storage facilities on your farm or ranch. The bales act like a thatched roof, keeping weather penetration to a minimum. Twine-wrapped Vermeer bales withstand repeated moving without excessive waste.

Both feedlot and pasture feeding are improved with the Vermeer One-Man Hay System. Cattle waste less hay because of bale compactness and increased palatability. You feed less often with the large bales, thereby cutting down on feeding time.

You can choose the method of feeding best suited to your operation. Simply set the bales out in a pasture-feeding area, use a feedbunk, or unroll them using the Vermeer Bale Carrier/Unroller. One man can easily handle the feeding chores previously demanding three men.

VERMEER MANUFACTURING COMPANY • **Phone 515 / 628-3141** • **Pella, Iowa 50219**

Vermeer Manufacturing Company reserves the right to make changes in engineering, design, and specifications, add improvements, or discontinue manufacture at any time without notice or obligation.

11-74-PC

HAWK BILT

model 480 Roll Baler

The Baler That's Winning The Race To Get The Hay-In

Bale up to 120 tons of hay a day!

The one-man way to handle hay!

Now, one man can bale up to 120 tons of hay in a single working day. At a time when labor costs are sky-rocketing, the Hawk Bilt 480 Roll Baler system saves time, labor and trouble thanks to an innovative design breakthrough. It produces quality hay in more efficiently handled bales at a lower cost than previously available equipment.

High Capacity. In fields with heavy stands, the Hawk Bilt Roll Baler can produce a 1,000 pound bale every 2½ minutes as it moves along at 5 mph. It lets you harvest up to 10 acres in a single hour. Bales produced are 7 feet long, 3 to 6 feet in diameter, weighing up to 1200 pounds depending on operator preference and crop.

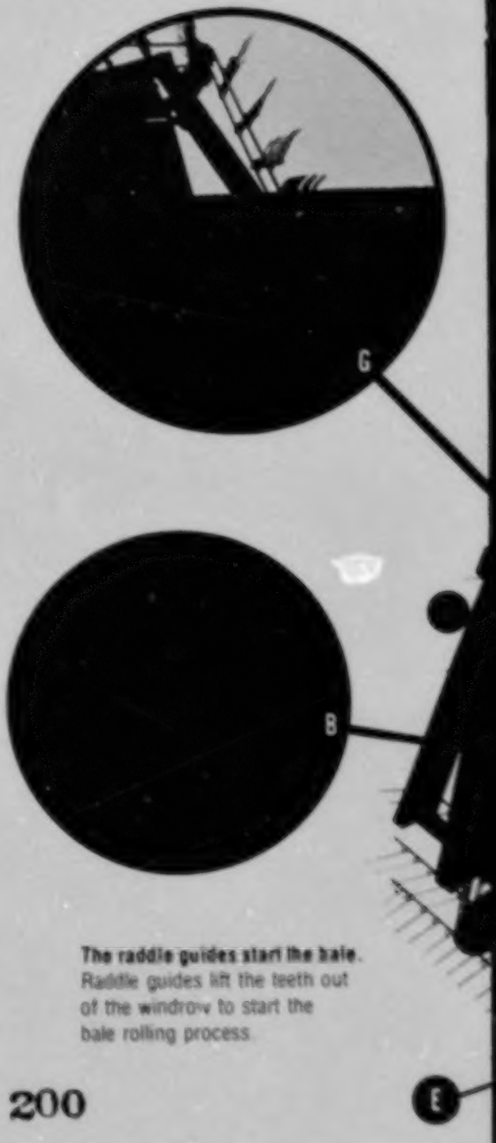
Less Maintenance, More Durability. The Roll Baler utilizes a simple design concept that eliminates intricate timing devices, wear-prone belts and twine/wire mechanisms. This means less maintenance, longer life.

Economical, Low Investment System. The Roll Baling System can save crop harvesting costs by reducing labor. Under most conditions, the Roll Baler eliminates the need for twine or wire, whose costs have approximately doubled in the past year, and whose availability may be a problem. This unit can be efficiently operated with a 35 hp. tractor unless terrain conditions restrict. A low initial investment can give you a complete baling and handling system . . . with the Hawk Bilt Roll Baler and the Hawk Bilt Bale Carrier.

Roll Bale Advantages. Because the Roll Baler rolls uniform bales that have a soft core, hay may be baled with a slightly higher moisture content allowing you to bale sooner than with conventional balers. Bales form their own watershed, eliminating the need for covered storage. They may be moved easily with a modified front end loader or a Hawk Bilt mounted carrier. Moving a single large roll bale replaces handling 20 to 25 standard size bales. Bales retain leaves that are frequently lost by bale compressors and plunger devices. Owners report cattle self-feeding from roll bales in the field or feeding devices.

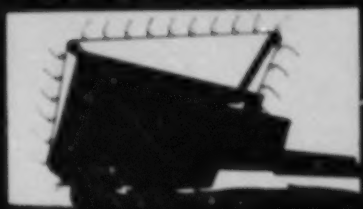
Versatility. Both the small farmer and the large commercial operator will enjoy the flexibility of the Hawk Bilt Roll Baler. It bales all kinds of forages including hay, grasses and residue crops efficiently.

Warranty. The Hawk Bilt Company warrants to each new purchaser of a baler that such equipment will be free from defects in materials or workmanship as received from an authorized Hawk Bilt dealer. The warranty extends for a period of 12 months from the date of delivery to the purchaser. The obligation of the Hawk Bilt Company under this warranty covers replacing parts which, in the company's judgement, prove defective under normal and proper use within the warranty period. This includes all parts.

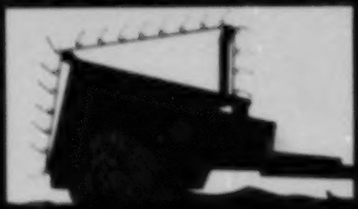


The raddle guides start the bale. Raddle guides lift the teeth out of the windrow to start the bale rolling process.

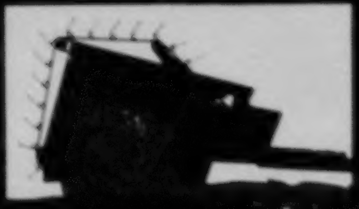
How the Hawk Bilt Roll Baler works.



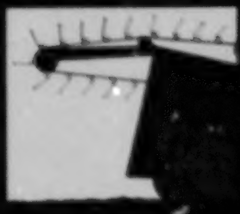
The raddle folds the windrow over



and begins rolling the hay up forming a large round bale.



A spring loaded take-up arm keeps the bale firm and in place



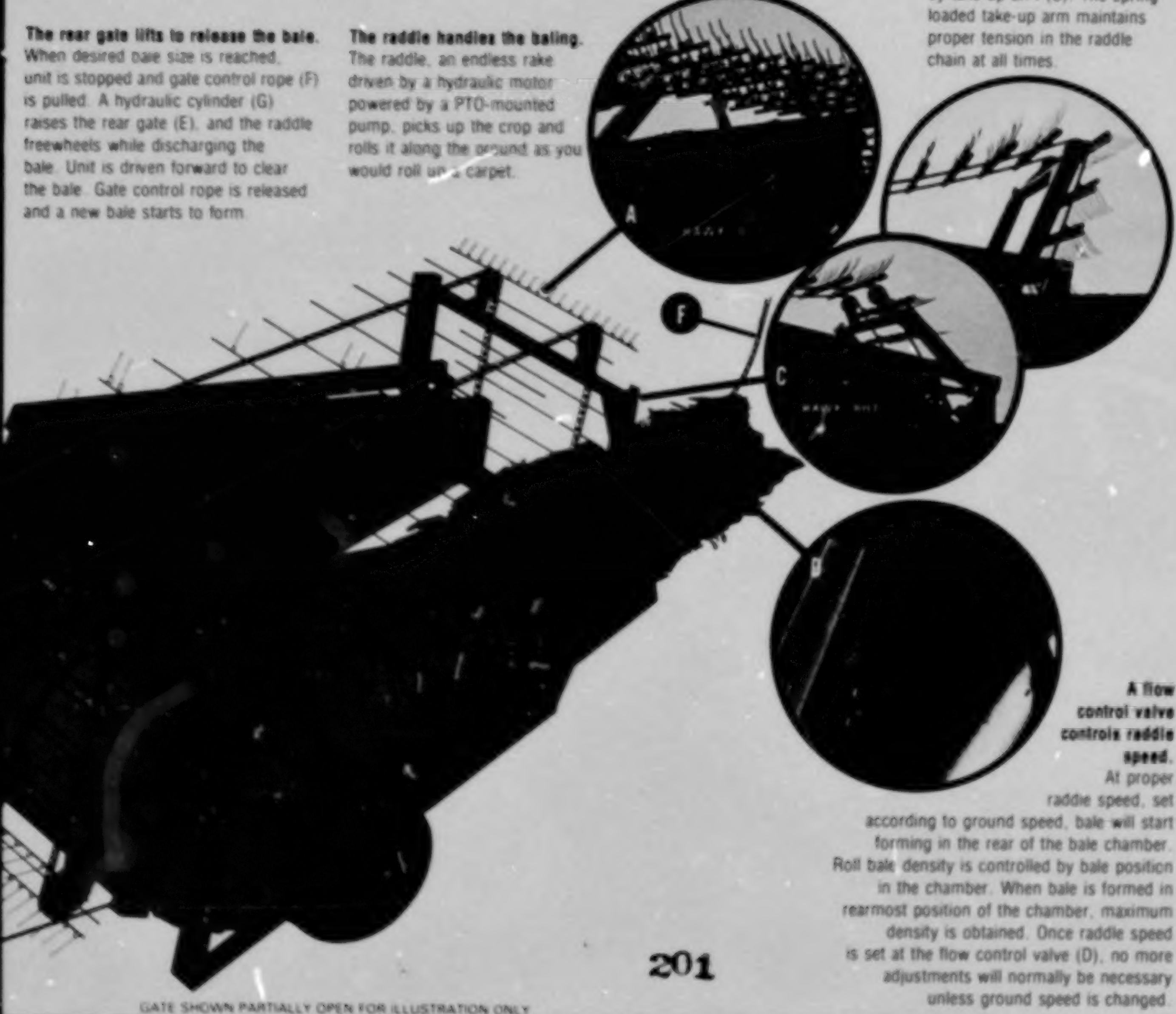
The gate control rop
to open the rear gat

The Hawk Bilt 480 Roll Baler simple as a rake... and built to do a big job.

The rear gate lifts to release the bale. When desired bale size is reached, unit is stopped and gate control rope (F) is pulled. A hydraulic cylinder (G) raises the rear gate (E), and the raddle freewheels while discharging the bale. Unit is driven forward to clear the bale. Gate control rope is released and a new bale starts to form.

The raddle handles the baling. The raddle, an endless rake driven by a hydraulic motor powered by a PTO-mounted pump, picks up the crop and rolls it along the ground as you would roll up a carpet.

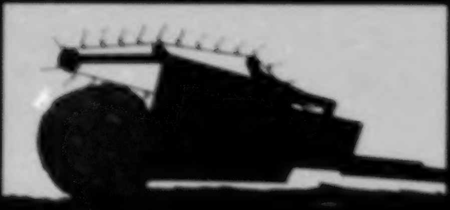
The take-up arm lets the bales grow. As the bale gets bigger, it raises the raddle, and increases raddle chain tension. Extra chain over bale is provided from the top chain loop supported by take-up arm (C). The spring loaded take-up arm maintains proper tension in the raddle chain at all times.



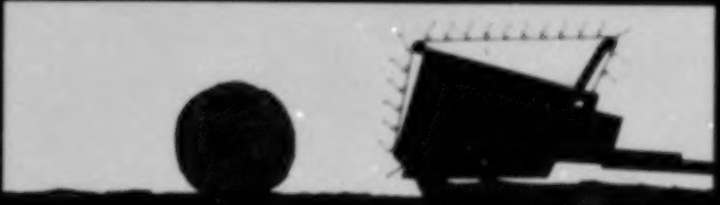
A flow control valve controls raddle speed. At proper raddle speed, set according to ground speed, bale will start forming in the rear of the bale chamber. Roll bale density is controlled by bale position in the chamber. When bale is formed in rearmost position of the chamber, maximum density is obtained. Once raddle speed is set at the flow control valve (D), no more adjustments will normally be necessary unless ground speed is changed.

GATE SHOWN PARTIALLY OPEN FOR ILLUSTRATION ONLY

pulled



The raddle freewheels and the bale is released



The gate closes and a new bale begins

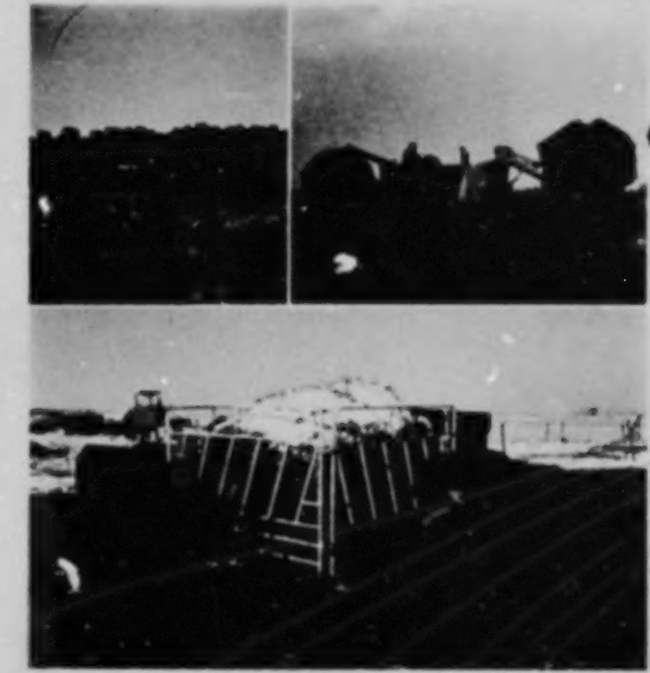
Fast, no-nonsense roll bale handling

The roll bales protect themselves . . . form their own thatched roof. They can be left in the field and, when time permits, moved and stored closer to the feed lot. Farmers report using roll bales as a windbreak for the feed lot.

Hawk Bilt manufactures a Bale Carrier for extra ease in moving large bales. It will fit tractors with a Category I or II three point hitch, and will handle a 1500 pound load. The Bale Carrier is also available with adapting brackets for universal mount on front end loaders . . . loaders with hydraulically controlled buckets recommended.

Feeding bales, too, is simple . . . from a hay bunk or off a flat bed wagon. Or, cattle can self-feed in the field from roll bales left on the ground or in a feeding device.

Roll bale all kinds of forage. Today, with farmers using short grasses, corn stalks and oat, wheat and soybean straw, as well as other crop residues, Hawk Bilt has built this Roll Baler to handle all kinds of forage. For use with hard-to-handle crops, a twine attachment is available.



specifications

[illegible]

OTHER QUALITY-ENGINEERED EQUIPMENT AVAILABLE FROM HAWK BILT

FLAIL-CHAIN MANURE SPREADER
a more versatile, durable, spreader

SELF-LOADING SPREADER
Saves time, manpower, and equipment investment

CONTINUOUS FLOW GRAIN DRYER
more features than just 2¢-per-bushel drying

MODEL 60 BALE CARRIER
easily handles today's giant bales

FERTILIZER SPREADERS
2-ton, 5-ton, and 8-ton models

"When Farmers Talk, Hawk Bilt Listens"

HAWK BILT COMPANY Vinton, Iowa 52349

A CHROMALLOY AMERICAN COMPANY

Adult Unit No. 6

SERVICE AND ADJUSTMENT OF PLANTING EQUIPMENT

A Resource Unit For Adult Education Classes in Agriculture

Developed by
John G. Roberts

Edited by
L. H. Newcomb

Department of Agricultural Education
College of Agriculture and Home Economics
The Ohio State University
Columbus, Ohio 43210

1975

Preface

This resource unit was developed as a part of a project titled, "Inservice Education of Vocational Agriculture Teachers on New Curricular Materials for Adult Class Instruction." Educational Professional Development Act Funds were obtained from the Regional U. S. Office of Education in Chicago through the State Department of Education, Division of Vocational Education in Ohio to conduct the project. The project was conducted from August 1, 1974 through July 31, 1975. Included in the project were workshops which provided instruction concerning development and utilization of the units.

The project staff consisted of J. David McCracken and Lawrence H. Newcomb, Project Co-Directors and Wayne R. Longbrake, Graduate Research Associate. Special appreciation is expressed to Mr. Longbrake who assumed much of the responsibility in assisting authors with the specific content of the units. Appreciation is also expressed to each of the vocational agriculture teachers in the State of Ohio who assisted with the project by developing units and by field testing the initial units prior to their revision and final preparation.

J. David McCracken
Assistant Professor

L. H. Newcomb
Assistant Professor

TABLE OF CONTENTS

	PAGE
PREFACE	III
INTRODUCTION	1
STATE SITUATION	3
LOCAL SITUATION	3
OBJECTIVES	3
REFERENCES	4
NEEDED AV EQUIPMENT	4
ALTERNATIVE INTEREST APPROACHES	4
QUESTIONS TO BE ANSWERED	5
LEARNING ACTIVITIES	5
TO SUMMARIZE (NOTE TO TEACHER)	6
APPLICATION (APPROVED PRACTICES)	6
APPENDIX A: CONTENT SUMMARY	8
APPENDIX B: INSTRUCTIONAL MATERIALS	23

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATIBLE TO THE LOCAL COMMUNITY.

SERVICE AND ADJUSTMENT OF PLANTING EQUIPMENT

STATE SITUATION

AS FIELD PLANTERS BECOME MORE SOPHISTICATED, THE NEED FOR PROPER AND TIMELY SERVICING BECOMES INCREASINGLY IMPORTANT. FARMERS, STATE WIDE, NEED TO BECOME ACQUAINTED WITH NEW PLANTERS AND TO BE CONSTANTLY REMINDED OF THE IMPORTANCE OF PROPERLY MAINTAINING PLANTERS. THIS LESSON, THOUGH SIMPLE ON THE SURFACE, CAN IMPROVE A SUCCESSFUL ADULT PROGRAM.

NOTE: EACH CLASS MEMBER SHOULD HAVE A COPY OF THE OPERATOR'S MANUAL FOR HIS PLANTER. THIS WILL BE NEEDED FOR CLASS EXERCISES.

LOCAL SITUATION

A. COMPARE THE DIFFERENT TYPES OF PLANTERS USED IN THE CLASS.

B. DRAW FROM MEMBERS SOME OF THE PRACTICES THEY FOLLOW IN SERVICING THEIR PLANTERS.

OBJECTIVES

1. DEVELOP A SET OF PROCEDURES TO CLEAN THE PLANTER AFTER USE AND PREPARE THE PLANTER FOR THE NEXT SEASON DURING THE NONCROP SEASON.
2. CALIBRATE THE PLANTER BEFORE PLANTING SEASON FOLLOWING APPROVED PROCEDURES.
   - A) SEED CORN AND SOYBEAN
   - B) LIQUID
   - C) DRY
3. PLAN AND ESTABLISH PLANTING RATES AND ROW SPACINGS.
4. PLAN TO SECURE SEED PLATES WELL IN ADVANCE OF PLANTING SEASON.
5. ESTABLISH A MAINTENANCE PROCEDURE PRIOR TO STORAGE.
6. CARE OF NO TILL PLANTERS, BARS, MONITOR SYSTEMS.
7. LUBRICATE THE PLANTER AND ACCESSORIES.

REFERENCES

ALDRICH, SAMUEL R. AND LENG, EARL R. MODERN CORN PRODUCTION. CINCINNATI, OHIO: F. AND W. PUBLISHING CORPORATION, 1965.

RATE OF PLANTING CORN. THE OHIO STATE UNIVERSITY, COLUMBUS, OHIO: VOCATIONAL AGRICULTURE SERVICE, OHIO DEPARTMENT OF EDUCATION, AGDEX 111/22, 1963.

RYDER, GORDON J. "AGRONOMIC TIPS." COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS - STATE OF OHIO. COLLEGE OF AGRICULTURE AND HOME ECONOMICS OF THE OHIO STATE UNIVERSITY AND THE UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING. COLUMBUS, OHIO: PUBLICATION NO. C-2, MARCH, 1962.

RYDER, GORDON J. "AGRONOMIC TIPS." COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS - STATE OF OHIO. COLLEGE OF AGRICULTURE AND HOME ECONOMICS OF THE OHIO STATE UNIVERSITY AND THE UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING. COLUMBUS, OHIO: PUBLICATION NO. C-3, APRIL, 1962.

SERVICE AND OPERATIONAL MANUALS--SECURE FROM MACHINERY DEALERSHIPS.

THE PLANTER, SELECTION AND MAINTENANCE. VOCATIONAL AGRICULTURE SERVICE, URBANA, ILLINOIS: VAS 3021.

NEEDED AV EQUIPMENT

1. BRING IN TWO (2) MODERN CORN PLANTERS AND TEST CALIBRATE THEM PRIOR TO ADULT CLASS.
2. A "PLANTING ASSEMBLY UNIT" MAY BE BORROWED FROM A LOCAL JOHN DEERE DEALER.
3. OVERHEAD PROJECTOR

ALTERNATIVE INTEREST APPROACHES

ALTERNATIVE A. DEVELOP A SET OF SLIDES SHOWING HOW MEMBERS OF THE CLASS HAVE SERVICED THEIR PLANTING EQUIPMENT.

ALTERNATIVE B. DEVELOP A CHART LOCALIZED TO YOUR AREA SHOWING THE ADVANTAGES OF EARLY PLANTING.

ALTERNATIVE C. BRING A PLANTER INTO LABORATORY WHICH HAS BEEN PROPERLY MAINTAINED. POINT OUT THE CHARACTERISTICS OF A WELL MAINTAINED PLANTER.

ALTERNATIVE D. SHOW PICTURES OF AN OLD PLANTER IN THE WEEDS. DISCUSS THE PROBLEMS CAUSED BY SUCH CARE.

ALTERNATIVE E. POINT OUT THAT PLANTING DELAYED FOR 30 DAYS FROM THE FIRST OF MAY COULD CAUSE A LOSS OF ONE BUSHEL PER DAY PER ACRE.

LOSS FROM DELAYS BECAUSE OF WEATHER CAN NOT BE PREVENTED BUT THOSE DELAYS BECAUSE OF IMPROPER OR NON-MACHINERY SERVICE CAN BE CORRECTED.

QUESTIONS TO BE ANSWERED

1. HOW SHOULD PLANTERS BE MAINTAINED?

2. WHAT STEPS SHOULD BE TAKEN IN PLANTER PREPARATION AND ADJUSTMENT?

3. WHAT STEPS SHOULD BE FOLLOWED IN CALIBRATING A PLANTER?

4. HOW SHOULD A PLANTER BE PREPARED FOR TRANSPORTING?

5. HOW DOES PLANTER OPERATION AND SAFETY EFFECT ACCURACY?

LEARNING ACTIVITIES

1. HOW SHOULD PLANTERS BE MAINTAINED?

USING TRANSPARENCY #1 AND HANDOUT #1 DISCUSS THE LOCATION OF FITTINGS, TYPE OF LUBRICANT AND FREQUENCY OF LUBRICATION. AS THESE FITTINGS ARE DISCUSSED INDICATE THEIR LOCATION IN THE SHOP ON A REAL PLANTER.

HAVE EACH PARTICIPANT USE HIS OPERATOR'S MANUAL TO DETERMINE THE LOCATION OF FITTINGS ON HIS PLANTER AND THE SERVICE REQUIREMENTS.

HAVE PARTICIPANTS CLEAN AND LUBRICATE THEIR OWN PLANTER EITHER IN THE SHOP OR AT HOME.

2. WHAT STEPS SHOULD BE TAKEN IN PLANTER PREPARATION AND ADJUSTMENT?

DISCUSS PLANTER RATES AND ROW SPACINGS AND THE ADJUSTMENTS FOR THE DESIRED SETTINGS.

DISCUSS PLANTER SEED PLATE SELECTION AND ITS EFFECT ON SEED DROP ACCURACY.

DEMONSTRATE THE EFFECT ON SEED DROP ACCURACY IN THE LAB.

USE TRANSPARENCIES #4 AND 5 TO DISCUSS PLANTER PREPARATION AND ADJUSTMENT.

3. WHAT STEPS SHOULD BE FOLLOWED IN CALIBRATING A PLANTER?

DISCUSS TRANSPARENCY #6 ON HOW TO DETERMINE SEED DROP.

USE TRANSPARENCIES #7-9 TO DISCUSS DRY FERTILIZER CALIBRATION.

DISCUSS TRANSPARENCY #10 ON DETERMINING LIQUID FERTILIZER RATES.

DISCUSS CALIBRATION OF GRANULAR HERBICIDES AND INSECTICIDES.

DEMONSTRATE THESE THINGS IN THE LAB.

4. HOW SHOULD A PLANTER BE PREPARED FOR TRANSPORTING?

USE TRNASPARENCY #11 TO DISCUSS THE GENERAL PROCEDURES.

DEMONSTRATE IN THE LAB.

5. HOW DOES PLANTER OPERATION AND SAFETY EFFECT ACCURACY?

USE TRANSPARENCY #12 TO SHOW THE EFFECT PLANTER PLATE SPEED HAS ON KERNEL DROP.

USE HANDOUT #2 TO DISCUSS PLANTER PROBLEMS.

USE TRANSPARENCY #13 TO DISCUSS SAFETY PRACTICES.

TO SUMMARIZE (NOTE TO TEACHER)

COMPARED TO THE PLOW THE PLANTER IS A RECENT INVENTION. YOUR ABILITY TO GET YOUR STUDENTS TO BECOME ENTHUSED ABOUT CARE AND MAINTENANCE OF THE PLANTER WILL BE IN DIRECT PROPORTION TO THE SUCCESS OF THIS LESSON.

THE TEACHER SHOULD BE AWARE OF JOHN DEERE'S PLATELESS PLANTER. WHITE'S VERTICAL PLATE, INTERNATIONAL HARVESTOR'S AIR PLANTER, AND THE OTHER INNOVATIONS IN THE FIELD OF PLANTERS.

BE SURE TO TEST CALIBRATE PLANTER BEFORE TRYING TO GIVE CLASS DEMONSTRATIONS. BECOME VERY FAMILIAR WITH OPERATOR'S MANUALS BEFORE CLASS.

APPLICATION (APPROVED PRACTICES)

1. NYLON PLATES WILL WEAR OUT CAST IRON THEREFORE NEED PROPER LUBRICATION.
2. ALWAYS SECURE PLATES IN SETS (4 FOR 4 ROW PLANTER).
3. HITCH PLANTER TO THE SAME TRACTOR WHICH IS TO BE USED WHEN CALIBRATING (LEVEL PLANTER).
4. HITCH HEIGHT CAN AFFECT SEED DEPTH.
5. CALIBRATE PLANTER AT FIELD SPEED.
6. DON'T TRANSPORT PLANTERS WITH FULL FERTILIZER AND SEED BOXES.

7. GREASE OVER DIRT MAKES A GOOD GRINDING COMPOUND.

8. ALLOW A FEW HUNDRED KERNELS EXTRA WHEN CALIBRATING ON A DRIVEWAY SINCE FIELD PLANTING RATE WILL BE BELOW CALIBRATION RATE.

9. KEEP A RECORD FROM ONE YEAR TO THE NEXT TO PROVIDE A COMPARISON.

APPENDIX A

CONTENT SUMMARY[1]

1. HOW SHOULD I MAINTAIN THE PLANTER?
2. WHAT PREPARATION SHOULD BE MADE TO USE THE PLANTER?
3. PLANTING RATE
4. ROW WIDTH
5. DRILLING DISTANCES
6. PLANTING DEPTH
7. PLANTER PLATE SELECTION AND ITS EFFECT ON SEED DROP ACCURACY
8. HIGH SPEED PLANTING CAN REDUCE KERNEL DROP
9. PLANTER ADJUSTMENT
10. PLANTER CALIBRATION
11. FERTILIZER RATES AND LOCATIONS
12. HERBICIDE APPLICATIONS
13. INSECTICIDE APPLICATIONS
14. SAFETY PRACTICES

---

[1] THE MAJOR PORTION OF THE CONTENT SUMMARY WAS CONDENSED FROM THE PLANTER, SELECTION AND MAINTENANCE. VOCATIONAL AGRICULTURE SERVICE, URBANA, ILLINOIS: VAS 3021.

HOW SHOULD I MAINTAIN THE PLANTER?

CARE AND MAINTENANCE OF THE CORN PLANTER IS IMPORTANT FOR TWO REASONS. (1) THE CORN PLANTER IS USED ONLY A FEW DAYS EACH YEAR. THE PERFORMANCE OF THE PLANTER DURING THE FEW HOURS IT IS IN THE FIELD MAY MAKE THE DIFFERENCE BETWEEN A PROFIT OR A LOSS ON THE CROPS IT PLANTS. ON A FARM WHERE THE PRINCIPAL CROPS ARE ROW CROPS, THE POOR PERFORMANCE OF THE PLANTER MAY MEAN FINANCIAL RUIN. SINCE ITS PERFORMANCE IS SO IMPORTANT, IT DESERVES GOOD CARE DURING THE REST OF THE YEAR WHEN IT IS NOT IN USE. (2) PLANTERS ARE PRECISELY MADE FARM IMPLEMENTS AND THEY ARE EXPENSIVE. EQUIPMENT THAT REPRESENTS THIS LARGE AN INVESTMENT SHOULD RECEIVE GOOD CARE. GOOD CARE AND MAINTENANCE WILL ASSURE EFFICIENT AND ACCURATE PLANTING AT HIGH SPEEDS FOR MANY YEARS.

REMEMBER, GOOD CARE AND LONG SERVICE GO TOGETHER. HOW LONG YOUR PLANTER WILL LAST AND CONTINUE TO DO GOOD WORK DEPENDS LARGELY ON THE MAINTENANCE AND CARE GIVEN BY THE OPERATOR.

STORE THE PLANTER ON BLOCKS OR JACKS. BLOCK UP THE RUNNERS SO THE WEIGHT OF THE PLANTING UNITS DOES NOT REST ON THE PRESS WHEEL TIRES. THIS WILL PREVENT DEFORMITY OR FLAT SPOTS CAUSED BY THE TIRES BEING DEPRESSED FOR A LONG PERIOD OF TIME. STORE THE PLANTER IN A SHED OR COVER THE ENTIRE UNIT WITH A TARPAULIN.

REPLACEMENT PARTS

THE FIRST STEP IN POST-SEASON SERVICE AND REPAIR IS TO DETERMINE IN DETAIL THE NEEDED REPLACEMENT PARTS, ADJUSTMENTS, AND SERVICE. THESE JOBS SHOULD BE MARKED WITH TAGS ON THE PLANTER OR WRITTEN DOWN IN A NOTEBOOK OR ON A SERVICE INSPECTION SHEET.

PARTS THAT ARE BROKEN OR BADLY WORN MAY NEED TO BE REPLACED. REFER TO THE OWNER'S MANUAL AND ORDER THESE PARTS BY THE CORRECT PART NUMBER. SOME WORN PARTS CAN BE BUILT UP IN THE SHOP. PARTS THAT ARE WEARING BY SOIL ABRASION MAY BE HARD SURFACED TO PROLONG THEIR LIFE.

CLEAN THE PLANTER BY REMOVING GREASE, DIRT, CHEMICALS, ETC. THIS CAN BE DONE WITH WATER PRESSURE. THE ACCUMULATION OF GREASE MAY BE SOFTENED WITH SOLVENT AND REMOVED BY PUTTY KNIFE OR WIRE BRUSH.

GREASE THE POLISHED SURFACE OF ALL GROUND WORKING PARTS OF THE PLANTER (FERTILIZER OPENER, RUNNERS, MARKER, ETC.).

LUBRICATE CHAINS WITH HEAVY OIL OR GREASE.

THE WORST ENEMY OF DRY FERTILIZER DISTRIBUTION EQUIPMENT IS CORROSION. EMPTY THE HOPPERS AS SOON AS POSSIBLE AFTER PLANTING IS COMPLETED. WASH OUT THE HOPPER, TUBE, AND OPENER THOROUGHLY. REMOVE THE AUGERS AND CLEAN THEM THOROUGHLY. USE A WIRE BRUSH IF NECESSARY TO REMOVE ANY ACCUMULATION OF FERTILIZER. SOME MANUFACTURERS RECOMMEND REPAINTING SCARRED SURFACES WITH AN AEROSOL SPRAY CAN TO PREVENT CORRO-

SION. PROTECT THE PARTS SUBJECT TO RUSTING WITH OIL, GREASE, PAINT, OR ANY SUITABLE RUST PREVENTATIVE.

AS DOUBLE DISK OPENERS WEAR, THE DISKS OF THE OFFSET TYPE CAN BE EXCHANGED BECAUSE THE LEADING DISK WEARS FASTER.

FOR LIQUID FERTILIZER ATTACHMENTS, OPEN THE DISTRIBUTOR VALVE AND FLUSH THE SYSTEM WELL. IF THE TANKS ARE METAL, ADD A PINT OF LIGHT OIL TO THE FINAL FLUSH. USE COMPRESSED AIR TO CLEAN AND DRY THE LIQUID FERTILIZER SYSTEM.

WHAT PREPARATION SHOULD BE MADE TO USE THE PLANTER?

1. CLEAN THE PLANTER THOROUGHLY. BE SURE THERE ARE NO OBSTRUCTIONS IN THE VALVES.
2. INFLATE THE PLANTER TIRES TO THE PRESSURE SUGGESTED IN THE OPERATOR'S MANUAL.
3. MOVE THE PLANTING UNITS TO THE DESIRED ROW WIDTHS. SET THE FERTILIZER OPENERS AS RECOMMENDED IN THE OPERATOR'S MANUAL. SET THE MARKERS FOR THE ROW WIDTH CHOSEN.
4. INSPECT THE SEED HOPPER BOTTOMS. BE SURE THE CUT-OFF PAWLS AND KNOCKERS ARE FREE.
5. SET THE HITCH CLEVIS SO THE PLANTER IS LEVEL WHEN OPERATING.
6. BE SURE THE MARKER-CONTROL LATCH IS LUBRICATED AND WORKING FREELY.
7. BE SURE ALL SET SCREWS AND BOLTS ARE TIGHT AND ALL COTTERS SPREAD, TO KEEP THEM FROM FALLING OUT.
8. BE SURE ALL HOSE CONNECTIONS AND GASKETS ARE TIGHT ON LIQUID FERTILIZER ATTACHMENTS. IF DRY FERTILIZER PARTS WERE OILED WHEN THE PLANTER WAS STORED, WIPE ALL PARTS DRY.
9. SET THE PLANTING DEPTH DESIRED.
10. CHECK THE PLANTER PARTS FOR EXCESSIVE WEAR.
11. MATCH THE SEED TO THE SEED PLATE AS DISCUSSED ABOVE. CHECK SEED PLATES FOR WEAR. IF THE CENTER OF THE SEED PLATE IS WORN, THERE WILL BE SO MUCH PLAY BETWEEN THE SEED PLATE AND THE SIDE OF THE HOPPER BOTTOM THAT THERE WILL BE AN IMPERFECT CELL FILL.
12. CALIBRATE THE SEEDING RATE AT THE CORRECT PLANTING SPEED.
13. CALIBRATE THE FERTILIZER APPLICATOR.
14. CALIBRATE THE PESTICIDE APPLICATOR(S).

LUBRICATION

FIRST OF ALL, CONSULT THE LUBRICATION CHARTS IN THE OPERATOR'S MANUAL FOR INSTRUCTIONS ON LUBRICATING THE PLANTER. CHECK THE OIL LEVEL IN THE GEAR CASE IF THE PLANTER IS SO EQUIPPED. KEEP THE CLUTCH (OR CLUTCHES) WELL LUBRICATED FOR POSITIVE AND EASY ACTION. MARKER CHAINS LAST LONGER AND OPERATE EASIER IF THEY HAVE A LIGHT COATING OF OIL. CHAIN TIGHTENERS THAT TURN FREELY PROVIDE LESS RESISTANCE TO THE MOVING CHAIN SO IT IS ADVISABLE TO KEEP THEM WELL LUBRICATED.

FOLLOW THE MANUFACTURER'S RECOMMENDATIONS ON DAILY LUBRICATION.

PLANTING RATE

THE IMPORTANCE OF CORRECT PLANTING RATE HAS BEEN MENTIONED EARLIER. SELECT THE PROPER POPULATION FOR THE FERTILITY AND MOISTURE LEVEL OF YOUR FIELD.

THE PLANT POPULATION AT HARVEST TIME IS USUALLY LESS THAN THE NUMBER OF KERNELS PLANTED OR ASSUMED TO HAVE BEEN PLANTED. THIS REDUCTION IN NUMBER CAN BE CAUSED BY ALL OR ANY ONE OF THE CAUSES DISCUSSED HERE. WHEEL SLIPPAGE AT PLANTING TIME, LOSSES FROM CULTIVATION, DAMAGE BY INSECTS, COMPETITION FROM WEEDS, AND FAILURE TO GERMINATE USUALLY REDUCES THE POPULATION 15 TO 20%.

BUYING POORLY GRADED SEED CAN CAUSE INACCURATE PLANTING. A SEED PLATE ACTUALLY GRADES SEED CORN. LARGER KERNELS TEND TO BE RETAINED IN THE HOPPER WHILE SMALLER ONES ARE PLANTED. FOR THIS REASON, IT IS A GOOD IDEA TO DUMP ALL HOPPERS OCCASIONALLY BECAUSE THE LARGER KERNELS ACCUMULATE AND MAY ACTUALLY PREVENT GOOD CELL FILL. FAILURE TO DO THIS HAS CAUSED SOME FARMERS TO HAVE A DIMINISHING PLANT POPULATION FROM THE DESIRED PLANTING RATE THEY STARTED WITH.

ROW WIDTH

CHANGING ROW WIDTHS IS CURRENTLY RECEIVING A GREAT DEAL OF ATTENTION. THERE IS ALWAYS INTEREST AMONG GOOD FARMERS IN WAYS TO INCREASE CORN YIELDS. ONE METHOD THAT HAS ATTRACTED CONSIDERABLE INTEREST IS TO CHANGE TO NARROW-ROW CORN. THE AGRONOMY DEPARTMENT OF THE UNIVERSITY OF ILLINOIS HAS FOUND THAT AT HIGH YIELD LEVELS, CORN YIELDS BENEFIT ABOUT FIVE PERCENT FROM NARROWING ROWS FROM 40 INCHES TO 30 INCHES. IN NO CASE DID THEY FIND CORN PLANTED IN 30-INCH ROWS YIELDING LESS THAN CORN PLANTED IN 40-INCH ROWS. SOYBEAN YIELDS HAVE BEEN FOUND TO INCREASE FROM 10 TO 15% DUE TO NARROW ROWS.

LODGING AND STALK BREAKAGE IN CORN SEEM TO INCREASE WITH NARROW ROWS. SHORTER, EARLIER HYBRIDS YIELD BETTER THAN TALL LATE VARIETIES.

NARROW-ROW CORN MAKES MORE EFFICIENT USE OF LIGHT AND MOISTURE AND THERE IS LESS COMPETITION FROM WEEDS. CHANGING TO NARROW ROWS IS PRIMARILY AN ECONOMIC DECISION AND MANY FACTORS MUST BE CONSIDERED BEFORE MAKING THE CHANGE.

STUDY YOUR PLANTER AND THE OPERATOR'S MANUAL. CAN ROW WIDTH BE VARIED? WHAT ROW WIDTHS ARE POSSIBLE? HOW CAN ROW WIDTHS BE CHANGED? MUST THE FERTILIZER DISCHARGE BE CHANGED? WILL IT BE NECESSARY TO CHANGE THE MARKER IF ROW WIDTHS ARE CHANGED?

DRILLING DISTANCES

DRILLING DISTANCES ARE DETERMINED BY THE CHOICE OF SEED PLATE, CHOICE OF SPROCKETS (DRIVE AND DRIVEN), AND THE CHOICE OF SELECTOR LEVER POSITION.

NOTICE THAT INCREASING THE NUMBER OF CELLS IN THE SEED PLATE REDUCES THE DRILLING DISTANCES. THIS IS LOGICAL, BECAUSE WITH THE SEED PLATE TURNING AT THE SAME RATE THE INCREASED NUMBER OF OPENINGS WILL PERMIT SEEDS TO DROP CLOSER TOGETHER.

ONE MODEL PLANTER POWER DRILLS ONE SEED AT A TIME BY BOLTING TWO EXTRA EJECTOR LUGS TO THE ROTOR. IF STRAIGHT DRILLING IS DESIRED, THE ACCUMULATOR PLATE IS REMOVED. BY REMOVING THE VALVE, THE PLANTER CAN BE MADE TO OPERATE LIKE A DRILL PLANTER.

PLANTING DEPTH

ON TRAILING PLANTERS THE PLANTING DEPTH IS GAUGED BY THE PRESS WHEEL AND NOT THE HYDRAULIC CYLINDER. THE DEPTH OF EACH UNIT IS ADJUSTED BY SETTING A DEPTH ADJUSTING PIN. MOVING THE PIN UP ONE HOLE ADDS APPROXIMATELY 1/2 INCH TO THE PLANTING DEPTH. THE PRESSURE ON THE PRESSURE SPRINGS HELPS INSURE UNIFORM PLANTING DEPTH.

PLANTER PLATE SELECTION AND ITS EFFECT ON SEED DROP ACCURACY[2]

UNIFORM STANDS AND HIGHER PLANT POPULATIONS ARE MORE CERTAIN BY SELECTION OF THE CORRECT PLANTER PLATE. THE SEED PLATE SIZE SHOULD BE

---

[2] RYDER, GORDON J. "AGRONOMIC TIPS." COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS, STATE OF OHIO. THE OHIO STATE UNIVERSITY AND THE UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING. COLUMBUS, OHIO: PUBL. NO. C-2, MARCH, 1962.

CHECKED FOR EACH LOT OF SEED CORN, PARTICULARLY WHEN CHANGING HYBRIDS. MOST SEED CORN HAS A RECOMMENDED PLATE NUMBER FOR EACH BAG OF SEED. THE SHAPE AND SIZES OF THE CORN KERNELS VARY BECAUSE OF DIFFERENCES IN HYBRID, FERTILITY LEVELS IN THE SEED FIELD, AND MOISTURE CONDITIONS. THE SIZES OF GRADED SEED CORN VARY DUE TO THE GRADING PROCEDURES OF THE SEED PRODUCERS.

KERNEL LENGTH IN FLAT GRADES OF CORN IS PROBABLY THE MOST CRITICAL DIMENSION IN THE SELECTION OF A SEED PLATE FOR PROPER CELL SIZE. UNIFORMLY SIZED ROUND GRADES WILL PLANT MORE ACCURATELY THAN FLAT GRADES BECAUSE THEY HAVE ONLY ONE GENERAL DIMENSION WHICH IS THE DIAMETER OF THE KERNEL.

THE EDGE DROP SEED PLATES IN T-4 SHOWS THREE PLATES EACH WITH DIFFERENT CELL LENGTHS AND THE WAY KERNELS OF THE SAME LENGTH FIT INTO THE CELLS. IN THE TOP SEED PLATE, THE CELLS ARE TOO SHORT FOR THE KERNELS SHOWN. MANY OF THESE KERNELS WILL BE WEDGED IN THE CELL AND WILL NOT BE EJECTED FROM THE CELL BY THE KNOCK-OUT ROLLER. SOME KERNELS MAY BE CRACKED OR DAMAGED; OTHERS WILL BE PUSHED OUT OF THE CELL AS IT PASSES UNDER THE KNOCK-OUT HOUSING. EACH CELL FAILING TO DROP A VIABLE KERNEL, OR EACH CELL EJECTING A CRACKED KERNEL, WILL REDUCE THE STAND 6 1/4% ON EACH REVOLUTION OF A 16-CELL PLATE.

THE CENTER PLATE IN T-4 SHOWS THE PROPER CLEARANCE. THE SEED CELLS ARE 1/16" LONGER THAN THE LONGEST KERNELS IN A SEED LOT. THIS WILL GIVE AMPLE ROOM FOR THE KERNELS TO DROP INTO THE CELLS AS THE SEED PLATE ROTATES AT A HIGH SPEED.

THE BOTTOM SEED PLATE IN T-4 SHOWS WHAT WILL HAPPEN IF THE SEED CELLS ARE TOO LONG FOR THE KERNELS TO BE PLANTED. OFTEN TIMES, A CELL CAN PICK UP TWO KERNELS STANDING END-WISE IN THE CELL. AS THESE PASS UNDER THE KNOCK-OUT HOUSING, THEY MAY BE BROKEN, CRACKED OR PUSHED OUT OF THE CELL COMPLETELY. EXTENSIVE TESTING HAS SHOWN THAT AS HIGH AS 18 TO 20% OF THE KERNELS ARE CRACKED AND DAMAGED WHEN EXCESSIVELY LARGE PLATES ARE USED.

SEED CORN IS SIZED FOR WIDTH, THICKNESS, AND LENGTH OF KERNELS. THE WIDTH AND THICKNESS ARE VERY UNIFORM AND RELATIVELY EASY TO SIZE WITH THE PRESENT EQUIPMENT AVAILABLE. THE SIZING FOR KERNEL LENGTH IS MORE DIFFICULT AND TIME CONSUMING. THE VARIATIONS IN KERNEL LENGTH ARE GREATER THAN FOR EITHER THE WIDTH OR THICKNESS. MOST OF THE SEED PLATES FOR FLAT KERNELS ARE 20/64" THICK TO ACCOMODATE THE KERNEL WIDTH. THE CELLS ARE FROM 11/64" WIDE CORRESPONDING TO THE KERNEL THICKNESS. THE CELL LENGTHS RANGE FROM USUALLY 32/64" TO 44/64" LONG, AND EACH SIZE IS USUALLY LISTED BY PLATE NUMBERS.

THE LARGE FLAT KERNELS IN T-4 ARE 23/64" WIDE. IN MOST CORN PLANTERS THESE KERNELS ARE TOO WIDE TO PASS UNDER THE KNOCK-OUT HOUSING WITHOUT MANY OF THEM BEING CRACKED OR PUSHED OUT OF THE CELLS. TO ELIMINATE THIS PROBLEM, THE GROOVED SIDE OF THE SEED PLATE HOLDER OR FALSE PLATE SHOULD BE UP OR NEXT TO THE SEED PLATE, ALLOWING THESE WIDE KERNELS TO DROP INTO THE GROOVE. THE DEPTH OF THE GROOVE VARIES FROM 2/64" TO 4/64" DEPENDING UPON THE MAKE OF PLANTER. THE EXTRA CLEAR-

ANCE IN THE PLATE HOLDER GROOVE ALLOWS THE WIDE KERNELS TO PASS UNDER THE KNOCK-OUT HOUSING WITH LESS DAMAGE TO THE KERNELS.

MATCHING UNIFORMLY SIZED ROUND GRADES WITH THE PROPER SEED PLATE IN RELATIVELY EASY AMPLE CLEARANCE CAN BE ALLOWED FOR ACCURATE CELL FILL WITHOUT TWO KERNELS FITTING INTO A CELL CAUSING EXCESSIVE CRACKING. WHEN PLANTING LARGE ROUNDS THE PLATE HOLDER GROOVE MAY NEED TO BE NEXT TO THE SEED PLATE.

THE ROTATING SPEED OR RPM OF THE SEED PLATE IS A CRITICAL FACTOR IN A CELL FILL ACCURACY OF THE SEED CORN PLATES. THE USE OF 24-CELL PLATES INSTEAD OF 16-CELL PLATES WILL REDUCE THE RPM OF THE SEED PLATE BY 33%. THE TOP PLATE IN T-4 HAS 24 CELLS. COMPARE THE DISTANCE BETWEEN CELLS WITH THE 16-CELL PLATES BELOW IT. WHEN THE ROTATING SPEED OF THE SEED PLATE IS REDUCED, IT ALLOWS MORE TIME FOR THE KERNELS TO DROP INTO THE CELLS AND GIVES GREATER CELL FILL ACCURACY.

SEED BOX GRADING OCCURS WHEN THE PLATE HOLDER GROOVE IS IN THE WRONG POSITION OR WHEN THE CELL LENGTH IS TOO SHORT, PARTICULARLY IF THE SEED CORN HAS MUCH MORE THAN 4/64" VARIATION IN KERNEL LENGTHS. THE SMALLER KERNELS ARE SORTED OUT OF THE CORN IN THE BOX, THUS PERMITTING A LAYER OF THE LONGER AND/OR WIDER KERNELS TO BUILD UP IN THE BOTTOM OF THE SEED BOX. REPEATED REFILLING OF THE SEED BOXES INCREASES THE THICKNESS OF THIS LAYER WHICH CAUSES A REDUCTION IN CELL FILL. THIS CAUSES A POORER SEED CROP THAN ANTICIPATED. SEED BOX GRADING CAN BE REDUCED BY EMPTYING THE BOXES AFTER EACH SECOND OR THIRD REFILL. SAVE THIS SEED UNTIL THE SEED LOT IS PLANTED, THEN SELECT A DIFFERENT PLATE, IF NEEDED, FOR THESE LARGER KERNELS.

THE STEPS IN CHOOSING THE PROPER SEED PLATE FOR FLAT GRADES ARE:

1) SELECT THE SEED PLATE RECOMMENDED FOR THE SEED CORN BAG

2) PICK OUT SEVERAL OF THE LONGEST KERNELS FROM A HANDFUL OF CORN

3) FIT THESE LONG KERNELS IN THE SEED CELL OF THE RECOMMENDED PLATE

4) ALLOW 1/16" CLEARANCE FOR LENGTH

5) IF CLEARANCE IS GREATER OR LESS, TRY ANOTHER PLATE

6) ADJUST PLATE HOLDER OR FALSE PLATE FOR PROPER KERNEL WIDTH

7) CHECK SEED DROP IN PREPARED SEEDBED AT USUAL PLANTING SPEED

MANY FACTORS ARE INVOLVED IN CAUSING THE HARVEST STANDS TO BE LOWER THAN PLANNED. CAREFUL SELECTION OF THE SEED PLATES AND USING 24-CELL PLATES AT REASONABLE SPEEDS CAN LEAD TO GREATER PLANTING ACCURACY AND HIGHER PROFITS.

HIGH SPEED PLANTING CAN REDUCE KERNEL DROP[3]

HIGH-SPEED CORN PLANTING CAUSES REDUCED SEED DROP AND LOWER STANDS EVEN THOUGH PROPER PLATES ARE USED. COMBINATIONS OF HIGH PLANTING SPEED, THICK PLANTING RATES, AND INCORRECT SEED PLATES FREQUENTLY DECREASE THE SEED DROP TO BELOW 60% OF THE PLANTER MANUAL SETTING. FARMERS CAN ACCURATELY DETERMINE WHETHER THE STAND LOSSES ARE OCCURRING BEFORE OR AFTER THE CORN EMERGES.

ON 100 PLOT LOCATIONS IN THE MIAMI COUNTY DEMONSTRATION PROGRAM DURING 1959 AND 1960, FARMERS HAD A HARVEST STAND OF ABOUT 25% BELOW THE PLANTER SETTING. THE FARMERS SET THEIR CORN PLANTERS FOR A 7" SEED SPACING IN 40" ROWS, DRIVING AT ABOUT 5 MPH OR LESS, USING THE SEED PLATES RECOMMENDED FOR THE SEED LOT PLANTED. THE PLANTER SETTING FOR THIS SPACING WAS 22,400 KERNELS PER ACRE. STAND COUNTS IN THESE PLOTS SHORTLY AFTER EMERGENCE SHOWED AN AVERAGE STAND OF 18,600 PLANTS PER ACRE OR 17% LESS THAN THE PLANTER SETTING. THE HARVEST STANDS AVERAGED 16,800 PLANTS OR 25% LESS THAN THE PLANTER SETTING. MOST OF THE 17% LOSS IS DUE TO THE FAILURE OF THE KERNELS TO DROP AND ONLY A SMALL PORTION DUE TO GERMINATION.

THE ROTATING SPEED OF THE SEED CORN PLATE IS A MOST IMPORTANT FACTOR IN THE ACCURACY OF THE SEED CELL FILL. HIGH RPM OF THE SEED PLATE DOES NOT ALLOW SUFFICIENT TIME FOR THE KERNELS TO PROPERLY FIT INTO THE CELLS. TWO FACTORS AFFECT THE RPM OF THE SEED PLATES. INCREASING THE PLANTING SPEED AND/OR INCREASING THE PLANTING RATE WILL INCREASE THE RPM OF THE SEED PLATE. THIS IS SHOWN IN TABLE I.

TABLE I PLANTER PLATE SPEED

	16-CELL PLATE			24-CELL PLATE		
	KERNELS PER ACRE			KERNELS PER ACRE		
MPH	12,000 RPM	16,000 RPM	20,000 RPM	12,000 RPM	16,000 RPM	20,000 RPM
3	15.3	20.2	25.4	10.2	13.5	16.9
5	25.4	33.7	42.3	16.9	22.5	28.2
7	35.6	47.1	59.2	23.7	31.4	39.5

THE RPM INCREASES AS THE SPEED OF PLANTING INCREASES AS SHOWN BY READING DOWN IN THE COLUMNS. READING ACROSS THE COLUMNS, IT WILL BE NOTED THAT THE RPM OF THE SEED PLATE INCREASES AS THE PLANTING RATE IS

---

[3] IBID. PUB. NO. C-3, APRIL, 1962.

INCREASED FROM 12,000 TO 20,000 KERNELS PER ACRE. TABLE I ALSO SHOWS THAT THE RPM OF THE SEED PLATE INCREASES NEARLY FOUR TIMES WHEN BOTH PLANTING SPEED AND PLANTING RATE ARE INCREASED AT THE SAME TIME, FOR EXAMPLE, FROM INCREASING FROM 12,000 KERNELS AT 3 MPH TO 20,000 AT 7 MPH WHEN 16-CELL SEED PLATES ARE USED. THIS HIGH SPEED MEANS THAT 16 KERNELS ARE EXPECTED TO DROP OUT OF THE SEED CORN PLATES DURING EACH REVOLUTION. VERY CAREFUL SELECTION OF THE SEED CORN PLATE IS NECESSARY IF WE EXPECT THE CORN PLANTER TO DO AN ACCURATE JOB OF PLANTING WHEN WE ARE ATTEMPTING TO DROP 16 KERNELS PER SECOND.

THIS PROBLEM OF LOW SEED DROP IN HIGH SPEED PLANTING CAN BE PARTIALLY REMEDIED BY USING 24-CELL SEED PLATES. TABLE I SHOWS THAT THE RPM OF THE 24-CELL PLATES AT ANY ONE OF THE SPEED RATE COMBINATIONS IS APPROXIMATELY 33% LESS THAN THE RPM OF THE 16-CELL PLATES. THE LOWER SPEED GIVES MORE TIME FOR THE KERNELS TO DROP INTO THE CELLS WHICH HELPS TO INCREASE THE CELL FILL ACCURACY. FIELD TRIALS WERE MADE TO DETERMINE THE EXTENT OF THE SEED DROP DECREASE AT THREE SPEEDS USING THREE SEED CORN PLATE SIZES WITH A 4 ROW CORN PLANTER USING 16-CELL EDGE DROP PLANTER PLATES. IN THESE TRIALS, A UNIFORMLY SIZED LOT OF CORN (13X21-18) WAS SELECTED. THE VARIATION IN LENGTH WAS QUITE SMALL, 95% OF THE KERNELS WERE WITHIN A 4/64" VARIATION.

IN TABLE II THE SEED CORN PLATE DESIGNATIONS ARE:

TOO SHORT - LONGEST KERNELS FIT SNUGLY FOR CELL LENGTH.

RIGHT LENGTH - LONGEST KERNELS HAD 1/16" CLEARNACE FOR CELL LENGTH.

TOO LONG - LONGEST KERNELS HAD 1/8" CLEARANCE FOR CELL LENGTH.

THE PLANTER WAS SET TO DROP 20,000 KERNELS PER ACRE. THE KERNELS WERE CAUGHT IN THE CORN PLANTER BOOT WHILE DRIVEN OVER A MEASURED DISTANCE.

TABLE II KERNELS DROPPED AT THREE SPEEDS

USING THREE DIFFERENT SEED PLATES

CELL LENGTH	3 MPH	5 MPH	7 MPH
	KERNEL/ACRE	KERNEL/ACRE	KERNEL/ACRE
TOO SHORT	19,500 (3)*	17,500 (4)	11,500 (9)
RIGHT LENGTH	20,400 (3)	17,900 (3)	13,800 (10)
TOO LONG	22,500 (3)	22,100 (4)	20,600 (15)

* ( ) % BROKEN KERNELS.

THE TOTAL NUMBER OF KERNELS DROPPED, AS SHOWN IN TABLE II, DECREASED AS THE PLANTING SPEED INCREASED. THE NUMBER OF KERNELS DROPPED

AT A GIVEN SPEED INCREASED IN DIRECT PROPORTION TO THE INCREASE IN CELL LENGTH. WHEN THE RIGHT LENGTH SEED CELLS WERE USED IN THESE TRIALS, THE KERNEL DROP DECREASED ABOUT 10% BY CHANGING FROM 3 MPH TO 5 MPH. AN ADDITIONAL 20% DECREASE OCCURRED WHEN THE PLANTING SPEED WAS INCREASED TO 7 MPH. THE PERCENT OF BROKEN KERNELS, SHOWN IN PARENTHESES, INCREASED WITH BOTH SPEED AND LONGER SEED CELLS. THE PLANTING WAS VERY ACCURATE AT 3 MPH USING A SEED PLATE WITH THE CORRECT CELL LENGTH. IN MOST INSTANCES, A 24-CELL PLATE AT 5 MPH WILL METER THE CORN AT A COMPARABLE RATE TO A 16-CELL PLATE AT 3 MPH.

EACH YEAR IN OHIO, MANY ACRES OF CORN ARE FERTILIZED ADEQUATELY FOR HIGH YIELDS AND PLANTED FOR AN INTENDED HARVEST STANDS OF 16,000 - 18,000 PLANTS PER ACRE. STANDS FAR BELOW THIS ARE COMMON AT HARVEST TIME. MAXIMUM EFFICIENCY OF THE FERTILITY AND OTHER MANAGEMENT EFFORTS CANNOT BE OBTAINED WITH LOW PLANT POPULATIONS. CAREFUL SELECTION OF THE SEED CORN PLATES AND A PLANTING SPEED WHICH WILL INSURE ACCURACY OF SEED DROP WILL INCREASE CORN PROFITS.

PLANTER ADJUSTMENT

WITH OTHER FARM OPERATIONS LIKE PLOWING, CULTIVATION, OR HARVESTING, YOU HAVE AN EASY CHECK ON THE OPERATION AND EFFICIENCY OF THE MACHINE. JUST A GLANCE FROM THE TRACTOR SEAT WILL TELL YOU WHAT KIND OF JOB IS BEING DONE WHEN YOU ARE PLOWING. A MORE THOROUGH INSPECTION CAN BE QUICKLY MADE BY CHECKING DEPTH, ETC., AS YOU WALK AROUND THE PLOW. WITH THE CORN PLANTER, HOWEVER, A GLANCE AT THE FIELD BEHIND THE PLANTER WILL ONLY TELL YOU IF YOU ARE PLANTING IN STRAIGHT ROWS AND WITH SOME OF THE NEWER ATTACHMENTS EVEN THE WHEEL TRACKS MAY BE COVERED OVER. YOU CAN NOT REALLY TELL WHAT KIND OF JOB YOU'VE DONE WITH THE PLANTER UNTIL AT LEAST TEN DAYS AFTER PLANTING. AS THE CORN PLANTS EMERGE, YOU HAVE A CHECK ON THE EFFECTIVENESS OF THE INSECTICIDE. AS THE PLANTS CONTINUE TO GROW RAPIDLY, YOU HAVE A CHECK ON THE STARTER FERTILIZER APPLICATION AND AS THE PLANTS GROW IN A ROW ALMOST FREE OF WEEDS YOU HAVE A CHECK ON THE HERBICIDE APPLICATION. NOW, IT IS RELATIVELY TOO LATE TO MAKE ANY CORRECTION FOR THIS YEAR'S CROP. ANY CHECKS MUST BE MADE PRIOR TO THE PLANTING SEASON BY CAREFUL CALIBRATION OF THE PLANTER BEFORE THE RUSH OF THE PLANTING SEASON BEGINS.

THERE ARE MANY VARIATIONS IN PLANTING CONDITIONS! SOIL TYPES VARY FROM ONE FIELD TO ANOTHER; ONE PLANTING SEASON IS DAMP AND COLD; ANOTHER IS HOT AND DRY; AND ONE FIELD IS MORE FERTILE THAN ANOTHER. SOYBEANS MAY BE PROFITABLY PLANTED IN NARROWER ROWS THAN CORN. A PARTICULAR HYBRID THAT WAS PLANTED LAST YEAR IS NO LONGER AVAILABLE. A NEW VARIETY OF CORN SHOWS GREAT PROMISE.

FARMERS WANT PLANTERS THAT CAN BE ADJUSTED FOR DIFFERENT ROW WIDTHS, PLANTING RATES, HILL SPACINGS IN THE ROW, DRILLING DISTANCES, PLANTING DEPTHS, FERTILIZER RATES AND LOCATIONS, KINDS OF CROPS, HERBICIDE RATES, AND INSECTICIDE RATES. IN ORDER TO ADJUST A PLANTER TO MEET THESE AND OTHER VARIATIONS IN PLANTING CONDITIONS, YOU MUST BE FAMILIAR WITH PLANTER ADJUSTMENT.

PLANTER CALIBRATION

MAKE A DRY RUN WITH THE PLANTER AT THE RECOMMENDED PLANTING SPEED (4 MPH) BEFORE GOING INTO THE FIELD. MAINTAIN THE PLANTER IN THE RAISED POSITION AND ENGAGE THE SEED PLATE DRIVE. EACH ROW EQUALS 1/200TH OF AN ACRE. (SEE TABLE III) THE PER ACRE PLANTING RATE IS OBTAINED BY COUNTING THE KERNELS IN EACH ROW AND TIMES 200. (NO. OF KERNELS X 200 - RATE PER ACRE) THE FOLLOWING TABLE WILL PROVIDE THE DISTANCES TO TRAVEL FOR VARIOUS ROW WIDTHS.

TABLE III SEED CALIBRATION

ROW SPACING	DISTANCE TO TRAVEL	14,000	16,000	18,000	20,000	24,000
30	87	70	80	90	100	120
36	72	70	80	90	100	120
38	69	70	80	90	100	120
40	66	70	80	90	100	120

TABLE IV FERTILIZER CALIBRATION

ROW SPACING	DISTANCE TO TRAVEL
40	131'
38	138'
36	145'
30	175'

CHECK THE FERTILIZER RATE BY DRIVING A DISTANCE EQUAL TO 1/100TH OF AN ACRE. (SEE TABLE IV) A PLASTIC BAG ATTACHED TO EACH FERTILIZER SPOUT TO COLLECT THE FERTILIZER TO BE WEIGHED AND CALCULATED FOR EACH ROW. HOWEVER, IT MUST BE REMEMBERED THAT THE DRY FERTILIZER ATTACHMENT METERS VOLUME AND NOT WEIGHT.

FERTILIZER RATES AND LOCATIONS

DRY FERTILIZER

RATES OF DRY FERTILIZER ARE ADJUSTED BY SELECTING A LOW OR HIGH RATE AUGER AND BY SELECTING THE CORRECT SPROCKETS (DRIVE AND DRIVEN). TRANSPARENCY #7 SHOWS THE DRY FERTILIZER RATES IN POUNDS PER ACRE FOR ONE PLANTER WHILE TRANSPARENCY #3 SHOWS THE FERTILIZER RATES FOR ANOTHER PLANTER.

THE TRANSPARENCIES SERVE AS A GUIDE BUT THEY ARE NOT PRECISE. DRY FERTILIZER IS METERED BY VOLUME AND NOT BY WEIGHT SO THE WEIGHT METERED MAY VARY AS MUCH AS 100% FROM THE WEIGHT CALCULATED IN THE CHARTS. FOR ACCURATE METERING OF THE FERTILIZER, IT IS IMPORTANT THAT THE AUGERS BE PROPERLY ASSEMBLED -- THE LARGE TAPERED ENDS SHOULD BE ON THE OUTSIDE WITH THE SMALL TAPERS TOWARD THE CENTER. COMPLETE INFORMATION CAN BE FOUND IN THE OPERATOR'S MANUAL.

ON SOME PLANTERS THE FERTILIZER CAN BE APPLIED IN A SHORT BAND NEXT TO THE HILL WHEN HILL-DROP OR CHECK-ROW PLANTING CORN. A STRIKER PLATE IS SET TO TRIP THE PULL ROD ON THE FERTILIZER VALVES.

SHOP CALIBRATION CAN BE DONE WITH FERTILIZER IN THE HOPPER, AND THE PLANTER ON SUPPORTS BY PLACING A CONTAINER UNDER THE DISCHARGE OPENING AND TURNING THE WHEELS TEN REVOLUTIONS. MEASURE THE CIRCUMFERENCE OF THE TIRE AND CALCULATE THE DISTANCE TRAVELED. MULTIPLY THE DISTANCE BY THE WIDTH OF THE ROW. DIVIDE THIS FIGURE BY 43,560. THIS GIVES THE FRACTION OF AN ACRE COVERED. WEIGH THE FERTILIZER AND DIVIDE BY THE FRACTION OF AN ACRE COVERED. THE RESULT WILL BE APPROXIMATELY THE AMOUNT APPLIED PER ACRE. IT TAKES A GREAT DEAL OF EFFORT TO TURN THE WHEELS MANUALLY AT THE PROPER SPEED. ON SOME PLANTERS THE DIFFERENTIAL IN THE DRIVE MECHANISM MAY ALSO AFFECT THE CALIBRATED RATE OF APPLICATION. FIELD PLANTING CONDITIONS MAY CAUSE THE APPLIED RATE TO VARY GREATLY FROM THE RATE CALIBRATED IN THE SHOP.

THE FERTILIZER OPENERS HAVE A DRAWBAR LINKAGE THAT GIVES UNRESTRICTED FLOTATION (IF THEY ARE NOT INTEGRAL PARTS OF THE RUNNER OPENERS). THE SEPARATE OPENERS CAN BE SHIFTED TO PLACE FERTILIZER ON EITHER SIDE OF THE SEED AND BELOW IF DESIRED. THE DRAWBARS SHOULD RETAIN VERTICAL FLEXIBILITY WITH THE PRESSURE SPRINGS FOR PROTECTION AGAINST BREAKAGE AS WELL AS PENETRATION.

LIQUID FERTILIZER

RATES OF LIQUID FERTILIZER ARE DETERMINED BY THE METERING HEAD AND THE RATE OF TRAVEL. TRANSPARENCY #4 SHOWS THE APPROXIMATE DELIVERY RATES FOR A PLANTER. NOTICE THAT FOR ANY GIVEN ORIFICE, THE RATE OF APPLICATION DECREASES AS THE SPEED OF TRAVEL INCREASES.

HERBICIDE APPLICATIONS

THE GRANULAR APPLICATORS ARE MOUNTED ON THE PLANTER FRAME OR ON FENDERS OVER THE PRESS WHEELS, AND DISTRIBUTE A BAND OF GRANULAR HERBICIDE BEHIND THE PRESS WHEELS. MOST APPLICATORS ARE CONSIDERED GRAVITY FLOW DEVICES, SINCE THE RATE IS VARIED BY CHANGING THE SIZE OF OPENING IN THE HOPPER BOTTOM. THE ROTOR IN THE HOPPER SERVES PRIMARILY TO PREVENT BRIDGING AND ASSURE A SUPPLY OF GRANULES TO THE OPENING. THE AMOUNT OF MATERIAL FED IS MORE A FUNCTION OF TIME THAN OF DISTANCE TRAVELED. ANY CHANGES IN TRAVEL SPEED OR SIZE, SHAPE, OR DENSITY OF THE GRANULES REQUIRES RECALIBRATION.

THE LIQUID HERBICIDE IS USUALLY APPLIED UNDER PRESSURE FROM A SUPPLY TANK. THE NOZZLES ARE MOUNTED BEHIND THE PRESS WHEELS AND THE HEIGHT OF THE NOZZLES DETERMINES THE WIDTH OF PATTERN.

CALIBRATION OF GRANULAR

CALIBRATION OF GRANULAR PESTICIDES (HERBICIDES AND INSECTICIDES) SHOULD BE DONE FOR THE RATE (NUMBER OF POUNDS PER ACRE) AT THE NORMAL PLANTING SPEED. ATTACH A CLOTH BAG OVER THE DIFFUSER OR THE DISCHARGE TUBE, LOWER THE PLANTER AND DRIVE A COMPLETE ROW (PREFERABLY IN THE FIELD AT PLANTING SPEED). WEIGH THE HERBICIDE (OR INSECTICIDE) CAUGHT IN THE CLOTH BAG AND CALCULATE THE RATE PER ACRE.

MAKE THE NECESSARY ADJUSTMENTS AND RECHECK. THIS CALIBRATION SHOULD BE DONE FOR BOTH PESTICIDES FOR EACH PLANTING UNIT.

CALIBRATION OF LIQUID

CALIBRATION OF LIQUID HERBICIDE (AND INSECTICIDE) APPLICATORS CAN BE DONE BY THE FOLLOWING METHOD. DRIVE A MEASURED DISTANCE OF 176 FEET IN THE FIELD AT THE SPEED AT WHICH PLANTING WILL BE DONE. RECORD THE TIME IT TAKES TO TRAVEL TO 176 FEET. NOTE THE RPM OF THE ENGINE OR MARK THE THROTTLE QUADRANT. WITH THE TRACTOR AND PLANTER STATIONARY AND THE SPRAYING PRESSURE AT 20-40 PSI, PLACE A CONTAINER UNDER A NOZZLE AND ADVANCE THE THROTTLE TO THE RPM USED IN THE FIELD. MEASURE THE AMOUNT OF FLUID CAUGHT UNDER THE NOZZLE IN THE RECORDED TIME.

ADJUST PRESSURE OR CHANGE NOZZLES UNTIL THE PROPER OUTPUT IS OBTAINED.

INSECTICIDE APPLICATIONS

GRANULAR INSECTICIDE IS PLACED IN THE FURROW AT THE BACK OF THE RUNNER. GRANULAR APPLICATORS ARE MOUNTED ON THE PRESS WHEEL FENDERS OR ON THE PLANTER FRAME AND THE INSECTICIDE IS DELIVERED TO THE FURROW THROUGH A SPOUT CONNECTED TO THE REAR OF THE RUNNER.

LIQUID INSECTICIDE IS SOMETIMES APPLIED WITH LIQUID FERTILIZER. IF APPLIED SEPARATELY, IT SHOULD BE APPLIED IN THE FURROW AHEAD OF THE PRESS WHEEL.

TRANSPORTING THE PLANTER

THE HYDRAULIC CYLINDER ON TRAILING PLANTERS SHOULD BE EXTENDED OR RETRACTED AS FAR AS IT WILL GO. WHEN MOVING THE PLANTER, THE TRANSPORT LINK SHOULD BE CONNECTED. ON SOME PLANTERS IT IS ADVISABLE TO DETACH THE CHAIN DRIVE. THE PLANTER WILL NOT BE AS NOISY AND THERE WILL BE FAR LESS WEAR ON THE PARTS.

WAIT UNTIL THE PLANTER IS IN THE FIELD TO FILL LARGE FERTILIZER HOPPERS AND GRANULAR PESTICIDE APPLICATORS. THE DRY FERTILIZER TENDS TO PACK SO IT IS RECOMMENDED THAT A WRENCH BE USED TO TURN THE AUGER SHAFT AFTER MOVING THE PLANTER WITH THE HOPPERS LOADED. THIS TAKES SOME OF THE SHOCK LOAD OFF THE FERTILIZER DRIVE. TRANSPORTING HOPPERS FULL OF FERTILIZER HAS BEEN KNOWN TO PACK IT SO TIGHTLY THAT THE AUGERS HAVE BEEN BROKEN. KEEP THE HOPPER AND AGITATOR CLEAN AND FREE OF CAKED MATERIALS TO INSURE UNIFORM APPLICATION AT THE CALIBRATED RATE.

WHEN CONTOUR PLANTING IS NOT NECESSARY, IT IS SUGGESTED THAT THE FIELD BE WORKED CROSSWISE OR ON A SLIGHT DIAGONAL TO THE DIRECTION OF PLANTING SO THE MARKER LINES CAN BE SEEN MORE EASILY.

FIELD OPERATION

IT IS BEST IF THE PLANTER WHEELS FOLLOW IN THE WHEEL TRACKS OF THE TRACTOR, GIVING THE PLANTER GREATER STABILITY. DO NOT OPERATE THE PLANTER WITH PRESSURE SPRINGS ON THE FERTILIZER OPENERS OR RUNNER OPENERS COMPRESSED TIGHTLY.

DO NOT DRIVE NEARER THAN EIGHT ROWS OF THE END BEFORE RAISING THE PLANTER. TURN CAREFULLY AND SHARPLY AT THE ENDS OF THE FIELD TO BRING THE PLANTER IN PROPER LOCATION WITHOUT BACKING UP.

RAISE THE PLANTER UNITS BEFORE BACKING OR THE RUNNERS OR BOOTS WILL BECOME CLOGGED.

THE RUNNERS CAN BE FORCED OUT OF ALIGNMENT BY TURNING THE PLANTER AROUND IN HARD GROUND WITHOUT RAISING THE PLANTER UNITS.

DUMP THE SEED HOPPERS OCCASIONALLY TO ELIMINATE THE ACCUMULATION OF LARGER KERNELS.

SAFETY PRACTICES

1. PERMIT ONLY ONE PERSON ON THE TRACTOR WHILE THE TRACTOR AND PLANTER ARE IN OPERATION. NEVER PERMIT OTHERS (ESPECIALLY CHILDREN) TO RIDE ON THE PLANTER.

2. DO NOT DRIVE AT EXCESSIVE SPEED.

3. DO NOT CLEAN, LUBRICATE, OR ADJUST THE PLANTER WHEN IT IS IN MOTION.

4. BE ESPECIALLY CAREFUL WHEN OPERATING ON HILLSIDES BECAUSE THE TRACTOR MAY TIP SIDEWAYS IF IT STRIKES A HOLE, DITCH, OR BUMP.

5. LOWER THE PLANTER TO THE GROUND WHEN IT IS NOT IN USE. WHENEVER POSSIBLE, PERFORM SERVICE WORK AND ADJUSTMENTS WITH THE PLANTER ON THE GROUND. IF THE PLANTER MUST BE IN THE RAISED POSITION WHILE WORKING ON IT, BE SURE IT IS SECURELY SUPPORTED ON BLOCKS.

6. LEAVE AMPLE CLEARANCE WHEN MAKING TURNS.

7. LOCK THE MARKER CHAINS IN TRANSPORT POSITION AT ALL TIMES EXCEPT WHEN ACTUALLY PLANTING. MARKERS CAN BE ACCIDENTALLY TRIPPED CAUSING INJURY TO SOMEONE OR DAMAGE TO THE MARKER. KEEP THE LOOSE END OF THE MARKER CHAIN FROM DANGLING.

8. DO NOT HURRY WHEN WORKING AROUND IMPLEMENTS. HASTE CAUSES ACCIDENTS.

9. ALWAYS CHECK BEHIND THE PLANTER WHEN BACKING THE UNIT TO AVOID INJURING A PERSON OR DAMAGING THE PLANTER.

10. KEEP SMALL CHILDREN AWAY FROM THE PLANTER.

11. USE A SLOW MOVING VEHICLE EMBLEM WHEN TRANSPORTING THE PLANTER ON THE HIGHWAY IN THE DAYTIME. USE ACCESSORY LIGHTS FOR ADEQUATE WARNING TO OTHER VEHICLE OPERATORS AT NIGHT OR DUSK.

APPENDIX B

INSTRUCTIONAL MATERIALS

HANDOUTS

H-1: LUBRICATION CHART

H-2: PLANTER PROBLEMS

TRANSPARENCIES

T-1: LUBRICATION CHART

T-2: PLANTER UNIT

T-3: PLANTER PREPARATION

T-4: PLANTER PLATE SELECTION

T-5: KERNELS DROPPED WITH DIFFERENT PLATES

T-6: KERNEL CALIBRATION

T-7: FERTILIZER CALIBRATION

T-8: DELIVERY RATES OF DRY FERTILIZER

T-9: DELIVERY RATES OF DRY FERTILIZER

T-10: DELIVERY RATES OF LIQUID FERTILIZER

T-11: TRANSPORTING PLANTER

T-12: SEED PLATE RPM

T-13: SAFETY PRACTICES

LUBRICATION CHART

Location	Number of Fittings or Locations*	Lubricant		Frequency	
		oil	Pressure gun grease	twice daily	daily
Cylinder anchor bearing					
Drill shaft bearings					
Row Unit drive shaft bearings(front)					
(rear)					
Main drive shaft bearings					
Wheel frame pivot					
Throwout bearing					
Ring gear bearings					
Press wheel hubs					
Drive chain idlers					
Disk marker hubs					
Marker chain pulleys					
Marker trip timing dial					
Ratchet pawls					
Fertilizer Unit					
Intermediate shaft bearings					
Driving sleeve					
Drive sprocket					
Drive chain idlers					

Wipe the dirt from fittings before greasing. Apply sufficient lubricant to flush out the old grease and dirt. Wipe off excess grease because this accumulates dirt.

NOTE: Fill in according to your own planter using manufacturer's operations manual.

PLANTER PROBLEMS[1]

FURROW OPENERS NOT PENETRATING GROUND

Possible Causes	Remedy
1. Hard ground	1. Use pressure spring attachment to increase pressure on runners.
2. Worn out furrow openers	2. Replace worn out runner openers. Weld additional plate to replace worn portion of opener.
3. Fertilizer openers set too deep	3. Readjust fertilizer openers.
4. Planter not level	4. Adjust hitch clevis.

SEED OR FERTILIZER NOT PROPERLY COVERED

Possible Causes	Remedy
1. Soil condition	1. Use covering blades or covering disks.
	2. Adjust covering blades or disks.
	3. Prepare a better seedbed.
	4. Set planter deeper.

SINGLE DISK FERTILIZER OPENER NOT ENTERING GROUND

Possible Causes	Remedy
1. Depth set deeper than plowing depth	1. Prepare deeper seedbed.
	2. Adjust opener for shallower depth.

SOIL LOOSE AROUND SEED

Possible Causes	Remedy
1. Cloddy soil condition	1. Use rubber tires on press wheels. Use seed firming wheels. Prepare seedbed more thoroughly.

---

[1] The Planter, Selection and Maintenance. Vocational Agriculture Service, Urbana, Illinois: VAS 3021.

2.	Insufficient press wheel pressure	2.	Increase pressure on press wheels.

MARKERS NOT LATCHING

	Possible Causes		Remedy
1.	Chain stretched	1.	Shorten length of chain.
2.	Chain too long	2.	Shorten length of chain.

INACCURATE SEED DROP

	Possible Causes		Remedy
1.	Poorly graded seed corn	1.	Use seed that is graded more uniformly.
2.	Planter speed too fast	2.	Use recommended planter speeds. Check seed against seed plate on dealer's seed plate test stand at recommended speed. Reduce planter speed.
3.	Wrong seed plates	3.	Use recommended seed plates. Check seed against seed plate on dealer's seed plate test stand. Check planting rate in barn lot.
4.	Planter out of time	4.	Check timing of planter (see operator's manual for procedure).
5.	Floor plate turned wrong side up	5.	Check floor plate.
6.	Wrong false ring used	6.	Use correct false ring.
7.	Cut-off pawls or knocker not working	7.	Check for worn cut-off pawl. Check cut-off pawl springs. Check operation of knock-out pawls. Seed may get into housing of knock-out pawl and cut-off pawls. Pawls may be too rusty or too tight.
8.	Chain on wrong sprocket or too loose	8.	Check if chain is on correct sprockets. Tighten chain.
9.	Weak rockshaft spring	9.	Replace rockshaft spring.
10.	Valves out of adjustment	10.	Check valve adjustment.

11.	Obstruction in shank	11.	Check shanks for clear operation.
12.	No oil or oil too heavy in gear case	12.	Check kind and level of oil in gear case.
13.	Check heads and check forks not adjusted properly on check-row planter	13.	Check adjustment.

SCATTERING OF HILLS IN ROW

Possible Causes		Remedy	
1.	Planter out of time	1.	Retime planter (see operator's manual for correct procedure).
2.	Clogged boots or runners	2.	Do not back up with furrow openers in ground. Depth of split-row fertilizer boot set too deep.
3.	Planting too fast	3.	Use recommended planting speeds.
4.	Valve rod out of adjustment	4.	Readjust valve rod.
5.	Check shaft spring out of adjustment	5.	Adjust spring to proper tension or replace spring.
6.	Check shaft binding	6.	Check for interference of misalignment of check shaft.
7.	Worn runner openers	7.	Replace or repair runner openers.
8.	Poorly prepared seedbed	8.	Prepare seedbed more thoroughly to eliminate trash, roots, or grassy conditions.

MARKER LINE NOT VISIBLE

Possible Cause		Remedy	
1.	Marker shoe or disk improperly set	1.	Adjust angle of shoe or disk to drag smoothly on ground.
		2.	Place more weight on marker.

PLANTER DRIVE JERKING OR CATCHING

Possible Cause		Remedy	
1.	Drive chain too loose	1.	Tighten drive chain.

PLANTER MISSES SETS OF HILLS

Possible Causes	Remedy
1. Clutch not engaging properly	1. Adjust clutch or repair.
2. Roller or clutch stop level loose or worn	2. Tighten clutch stop lever. Replace worn clutch stop lever.
3. Clutch dog spring weak or broken	3. Replace clutch dog spring.

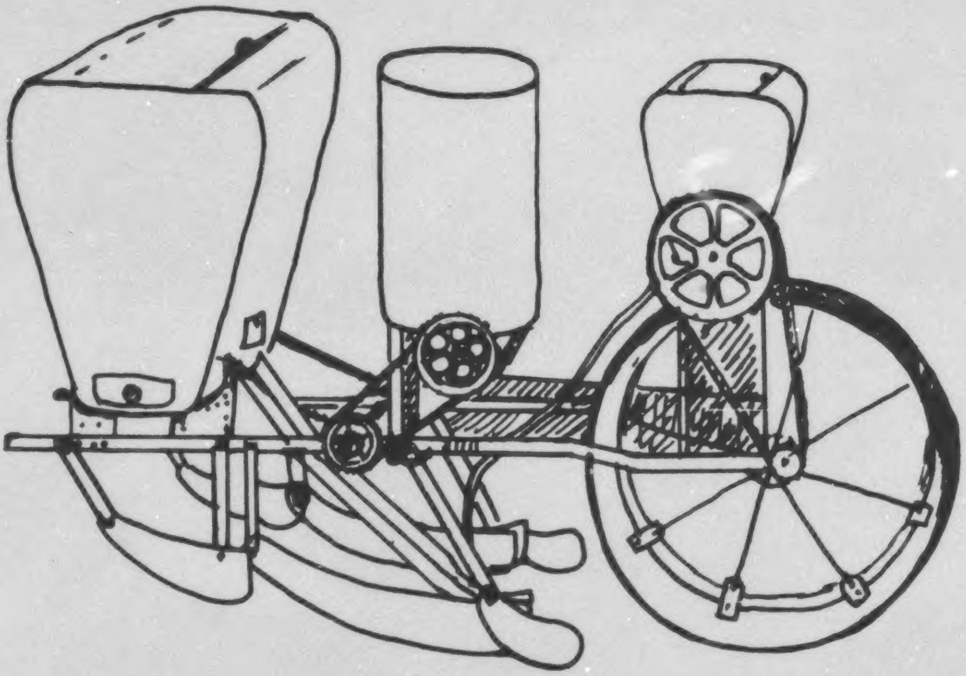
PLANTING MORE CORN IN SOME ROWS THAN IN OTHERS

Possible Causes	Remedy
1. Action of cut-off pawl or knocker	1. Check for seed in cut-off pawl or knocker housing. Check for weak or broken cut-off spring. Check for worn cut-off pawl.
2. Wrong seed plate	2. Check for uniformity of seed plates so they are the same in all planting units. Plates and hoppers are not all the same size which gives larger cell sizes in some hoppers.
3. Wrong false ring	3. Check for uniformity of false rings so they are the same in all planting units.
4. Warped false ring	4. Check condition of false rings.
5. Hopper not clamped down tight	5. Be sure all hoppers are clamped down tight.
6. Not enough corn in the hopper	6. Empty when 2 inches of corn remains in the hopper to remove larger kernels.

LUBRICATION CHART

LOCATION	NUMBER OF FITTINGS OR LOCATIONS*	LUBRICANT		FREQUENCY	
		OIL	PRESSURE GUN GREASE	TWICE DAILY	DAILY
CYLINDER ANCHOR BEARING	1				
DRILL SHAFT BEARINGS	6				
ROW UNIT DRIVE SHAFT BEARINGS (FRONT)	4				
(REAR)	4				
MAIN DRIVE SHAFT BEARINGS	3				
WHEEL FRAME PIVOT	4				
THROWOUT BEARING	1				
RING GEAR BEARINGS	4				
PRESS WHEEL HUBS	4				
DRIVE CHAIN IDLERS	2				
DISK MARKER HUBS	2				
MARKER CHAIN PULLEYS	5*				
MARKER TRIP TIMING DIAL	1*				
RATCHET PAWLS	2*				
FERTILIZER UNIT					
INTERMEDIATE SHAFT BEARINGS	2				
DRIVING SLEEVE	1				
DRIVE SPROCKET	1				
DRIVE CHAIN IDLERS	2				

WIPE THE DIRT FROM FITTINGS BEFORE GREASING. APPLY SUFFICIENT LUBRICANT TO FLUSH OUT THE OLD GREASE AND DIRT. WIPE OFF EXCESS GREASE BECAUSE THIS ACCUMULATES DIRT.



PLANTER UNIT

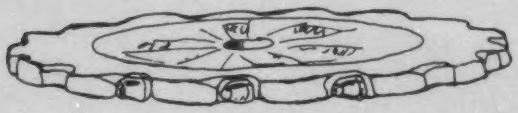
What preparation should be made to use the planter?

1. Clean the planter thoroughly. Be sure there are no obstructions in the valves.
2. Inflate the planter tires to the pressure suggested in the operator's manual.
3. Stop the tractor engine and let it cool before refueling. Do not smoke during refueling. A tractor fire will cause a greater delay in planting than a few seconds required to start the tractor engine.
4. Move the planting units to the desired row widths. Set the fertilizer openers as recommended in the operator's manual. Set the markers for the row width chosen.
5. Inspect the seed hopper bottoms. Be sure the cut-off pawls and knockers are free.
6. Set the hitch clevis so the planter is level when operating.
7. Be sure the marker-control latch is lubricated and working freely.
8. Be sure all set screws and bolts are tight and all cotters spread, to keep them from falling out.
9. Be sure all hose connections and gaskets are tight on liquid fertilizer attachments. If dry fertilizer parts were oiled when the planter was stored, wipe all parts dry.
10. Set the planting depth desired.
11. Check the planter parts for excessive wear.

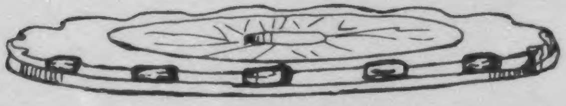
12. MATCH THE SEED TO THE SEED PLATE AS DISCUSSED ABOVE. CHECK SEED PLATES FOR WEAR. IF THE CENTER OF THE SEED PLATE IS WORN, THERE WILL BE SO MUCH PLAY BETWEEN THE SEED PLATE AND THE SIDE OF THE HOPPER BOTTOM THAT THERE WILL BE AN IMPERFECT CELL FILL.
13. CALIBRATE THE SEEDING RATE AT THE CORRECT PLANTING SPEED.
14. CALIBRATE THE FERTILIZER APPLICATOR.
15. CALIBRATE THE PESTICIDE APPLICATOR(S).

PLANTER PLATE SELECTION

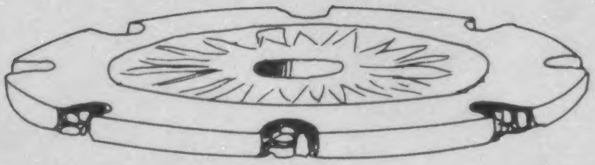
GOOD FIT = 1/16" CLEARANCE



CELL TOO SHORT



CELL RIGHT SIZE



CELL TOO LONG

KERNELS DROPPED AT THREE SPEEDS
USING THREE DIFFERENT SEED PLATES

CELL LENGTH	3 MPH	5 MPH	7 MPH
	KERNEL/ACRE	KERNEL/ACRE	KERNEL/ACRE
TOO SHORT	19,500 (3)*	17,500 (4)	11,500 (9)
RIGHT LENGTH	20,400 (3)	17,900 (3)	13,800 (10)
TOO LONG	22,500 (3)	22,100 (4)	20,600 (15)

* ( ) % BROKEN KERNELS.

T-5

SEED CALIBRATION

ROW SPACING	DISTANCE TO TRAVEL	NUMBER OF SEEDS PER ACRE				
		14,000	16,000	18,000	20,000	24,000
30	87	70	80	90	100	120
36	72	70	80	90	100	120
38	69	70	80	90	100	120
40	66	70	80	90	100	120

FERTILIZER CALIBRATION

ROW SPACING	DISTANCE TO TRAVEL*
40	131′
38	138′
36	145′
30	175′

_____ # FERTILIZER x 100 = _____ #/ACRE

* CHECK THE FERTILIZER RATE BY DRIVING A DISTANCE EQUAL TO 1/100TH OF AN ACRE.

DELIVERY RATES OF DRY FERTILIZER

(POUNDS PER ACRE)

---

*CALCULATED FOR 40-INCH ROW SPACING AND 10-10-10 FERTILIZER

POUNDS PER ACRE			DIFFERENTIAL SPROCKET	FERTILIZER SPROCKET
TYPE OF AUGER				
LOW	REG.	HIGH		
52	104	156	9-TOOTH	18-TOOTH
63	125	188	9-TOOTH	15-TOOTH
79	157	236	12-TOOTH	18-TOOTH
94	188	282	12-TOOTH	15-TOOTH
105	209	314	9-TOOTH	9-TOOTH
118	236	354	9-TOOTH	8-TOOTH
142	283	425	18-TOOTH	15-TOOTH
157	313	470	12-TOOTH	9-TOOTH
177	353	530	12-TOOTH	8-TOOTH
235	470	705	18-TOOTH	9-TOOTH
264	528	792	18-TOOTH	8-TOOTH

DELIVERY RATES OF DRY FERTILIZER

40" Rows

Sprocket on Main Drive Shaft	Sprocket on Fertilizer Feed Shaft	Pounds Per Acre	
		Low Rate Auger	High Rate Auger
8-Tooth	18-Tooth	50	115
8-Tooth	15-Tooth	60	140
12-Tooth	18-Tooth	75	170
12-Tooth	15-Tooth	90	205
8-Tooth	9-Tooth	100	230
17-Tooth	18-Tooth	105	240
8-Tooth	8-Tooth	110	260
17-Tooth	15-Tooth	130	290
12-Tooth	9-Tooth		340
12-Tooth	8-Tooth		385
17-Tooth	9-Tooth		485
17-Tooth	8-Tooth		540

DELIVERY RATES OF LIQUID FERTILIZER

(POUNDS PER ACRE)

*CALCULATED FOR 40" ROW SPACING

LOW RANGE

ORIFICE DISK NO. 1

SPEED			ORIFICE
3 MPH	4 MPH	5 MPH	NUMBER
42	31	25	1
67	50	40	2
100	75	60	3
150	112	90	4
183	138	110	5
200	150	120	6

HIGH RANGE

ORIFICE DISK NO. 2

SPEED			ORIFICE
3 MPH	4 MPH	5 MPH	NUMBER
242	181	145	1
283	212	170	2
325	244	195	3
392	294	235	4
420	315	252	5
483	362	290	6

EXTRA HIGH RANGE

ORIFICE DISK NO. 3

SPEED			ORIFICE
3 MPH	4 MPH	5 MPH	NUMBER
517	388	310	1
575	431	345	2
670	478	382	3
703	528	422	4
775	581	465	5

FACTORS TO CONSIDER IN TRANSPORTING PLANTER

- Retract or Extend Hydraulic Cylinders
- Connect Transport Link
- Detach the Chain Drive (on some planters)

PLANTER PLATE SPEED

	16-CELL PLATE			24-CELL PLATE		
	KERNELS PER ACRE			KERNELS PER ACRE		
	12,000	16,000	20,000	12,000	16,000	20,000
MPH	RPM	RPM	RPM	RPM	RPM	RPM
3	15.3	20.2	25.4	10.2	13.5	16.9
5	25.4	33.7	42.3	16.9	22.5	28.2
7	35.6	47.1	59.2	23.7	31.4	39.5

SAFETY PRACTICES

1. PERMIT ONLY ONE PERSON ON THE TRACTOR WHILE THE TRACTOR AND PLANTER ARE IN OPERATION. NEVER PERMIT OTHERS (ESPECIALLY CHILDREN) TO RIDE ON THE PLANTER.
2. DO NOT DRIVE AT EXCESSIVE SPEED.
3. DO NOT CLEAN, LUBRICATE, OR ADJUST THE PLANTER WHEN IT IS IN MOTION.
4. BE ESPECIALLY CAREFUL WHEN OPERATING ON HILLSIDES BECAUSE THE TRACTOR MAY TIP SIDEWAYS IF IT STRIKES A HOLE, DITCH, OR BUMP.
5. LOWER THE PLANTER TO THE GROUND WHEN IT IS NOT IN USE. WHENEVER POSSIBLE, PERFORM SERVICE WORK AND ADJUSTMENTS WITH THE PLANTER ON THE GROUND. IF THE PLANTER MUST BE IN THE RAISED POSITION WHILE WORKING ON IT, BE SURE IT IS SECURELY SUPPORTED ON BLOCKS.
6. LEAVE AMPLE CLEARANCE WHEN MAKING TURNS.
7. LOCK THE MARKER CHAINS IN TRANSPORT POSITION AT ALL TIMES EXCEPT WHEN ACTUALLY PLANTING. MARKERS CAN BE ACCIDENTALLY TRIPPED CAUSING INJURY TO SOMEONE OR DAMAGE TO THE MARKER. KEEP THE LOOSE END OF THE MARKER CHAIN FROM DANGLING.
8. DO NOT HURRY WHEN WORKING AROUND IMPLEMENTS. HASTE CAUSES ACCIDENTS.
9. ALWAYS CHECK BEHIND THE PLANTER WHEN BACKING THE UNIT TO AVOID INJURING A PERSON OR DAMAGING THE PLANTER.
10. KEEP SMALL CHILDREN AWAY FROM THE PLANTER.
11. USE A SLOW MOVING VEHICLE EMBLEM WHEN TRANSPORTING THE PLANTER ON THE HIGHWAY IN THE DAYTIME. USE ACCESSORY LIGHTS FOR ADEQUATE WARNING TO OTHER VEHICLE OPERATORS AT NIGHT OR DUSK.

ADULT UNIT NO. 7

MACHINERY SELECTION AND PRACTICES TO REDUCE TILLAGE OF ROW CROPS

A RESOURCE UNIT FOR ADULT EDUCATION CLASSES IN AGRICULTURE

DEVELOPED BY
RAY CLEVENGER

EDITED BY
L. H. NEWCOMB

DEPARTMENT OF AGRICULTURAL EDUCATION
COLLEGE OF AGRICULTURE AND HOME ECONOMICS
THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO 43210

1975

PREFACE

THIS RESOURCE UNIT WAS DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U. S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN
ASSISTANT PROFESSOR

L. H. NEWCOMB
ASSISTANT PROFESSOR

TABLE OF CONTENTS

PAGE

PREFACE III

INTRODUCTION 1

NATIONAL AND STATE SITUATION 3

LOCAL SITUATION 3

OBJECTIVES 3

REFERENCES 4

NEEDED AV EQUIPMENT 4

ALTERNATIVE INTEREST APPROACHES 4

QUESTIONS TO BE ANSWERED 4

LEARNING ACTIVITIES 5

APPLICATION 6

APPENDIX A: CONTENT SUMMARY 7

APPENDIX B: INSTRUCTIONAL MATERIALS 21

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES. THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATIBLE TO THE LOCAL COMMUNITY.

MACHINERY SELECTION AND PRACTICES TO REDUCE TILLAGE OF ROW CROPS

NATIONAL AND STATE SITUATION

BECAUSE PRODUCTION COSTS CONTINUE TO RISE IN THE FACE OF LOW PRICES RECEIVED FOR CROPS, FARMERS ARE CONTINUOUSLY FACED WITH THE PROBLEM OF PRODUCING CROPS MORE EFFICIENTLY. ONE OF THE MORE IMPORTANT MANAGEMENT DECISIONS FACING THE CROP FARMER IS TO DETERMINE THE MOST ECONOMICAL TILLAGE SYSTEM FOR HIS CROPPING PROGRAM. TYPICALLY, HE IS FACED WITH THE PROBLEM OF LIMITED CAPITAL, TIME, AND LABOR. IN MANY SITUATIONS HE MUST REDUCE HIS OPERATING COST BY REALLOCATING RESOURCES RATHER THAN ADDING RELATIVELY UNAVAILABLE RESOURCES, SUCH AS ADDITIONAL CAPITAL AND LABOR. THE PROPER SELECTION AND USE OF A FLEXIBLE TILLAGE SYSTEM CAN GIVE THE FARMER A MEANS OF REDUCING CROP PRODUCTION COSTS WITHOUT REDUCING PROFIT.

LOCAL SITUATION

FEW FARMERS HAVE ADOPTED MINIMUM TILLAGE PRACTICES. CONSIDERING THE WIDE RANGE OF SOIL TYPES, IT WOULD SEEM WISE FOR FARMERS TO CAREFULLY CONSIDER MEANS OF REDUCING TILLAGE IN AN EFFORT TO REDUCE THE COST OF PRODUCTION. FEW FARMERS SEEM ABLE TO ADAPT TO SEVERAL YEARS OF EXCESSIVE OR LIMITED RAINFALL. MANY ACRES ARE PLANTED AFTER THE OPTIMUM PLANTING DATE EACH YEAR BECAUSE OF THE INABILITY TO COMPLETE TILLAGE OPERATIONS UNDER LESS THAN IDEAL CONDITIONS: THIS IS COSTLY. (THIS POINT CAN BE MADE BY SHOWING TRANSPARENCY #1, "EFFECT OF DATE OF PLANTING..." AND TRANSPARENCIES #2, 3, AND 4 SHOWING PERCENTAGE OF CORN AND SOYBEANS PLANTED BY SELECTED DATES.)

NOTE - REDUCED TILLAGE OPERATIONS MAY NOT ALWAYS RESULT IN MORE TIMELY PLANTING IF THE SYSTEM CAUSES A PEAK DEMAND ON LABOR. TOTAL LABOR REQUIRED MAY BE LESS FOR SOME SYSTEMS, HOWEVER, IN CASE OF "PLOW AND PLANT," LABOR REQUIRED IS SPREAD OVER A SHORTER PERIOD OF TIME THEREBY CAUSING A PEAK LABOR DEMAND.

OBJECTIVES

THE LEARNER IS TO:

1. EXPLAIN THE EFFECT OF PLANTING DATE ON YIELD.
2. COMPARE AND CONTRAST AVAILABLE TILLAGE SYSTEMS.
3. SELECT A TILLAGE SYSTEM SUITABLE TO HIS FARMING PROGRAM.
4. COMPARE YIELDS, CASH RETURNS, TIME REQUIRED, MACHINERY AND HERBICIDE COSTS FOR CONVENTIONAL VERSUS REDUCED TILLAGE SYSTEMS.

REFERENCES

1974-75 OHIO AGRONOMY GUIDE. COOPERATIVE EXTENSION SERVICE, THE OHIO STATE UNIVERSITY.

FREDLINE, CLARENCE R. TILLAGE SYSTEMS. COLUMBUS, OHIO: OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, THE OHIO STATE UNIVERSITY, 1974. AGDEX 516.

FREDLINE, CLARENCE R. AND BONE, SAMUEL. "TILLAGE SYSTEMS FOR CORN AGDEX 111/510." COLUMBUS, OHIO: OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, THE OHIO STATE UNIVERSITY. SLIDE SERIES, 70 SLIDES.

PHILLIP, S. H. AND YOUNG, H. M. NO-TILLAGE FARMING. MILWAUKEE, WISCONSIN: REIMAN ASSOCIATES, 1973.

NEEDED AV EQUIPMENT

OVERHEAD PROJECTOR, SLIDE PROJECTOR (IF SLIDES AVAILABLE), PROJECTOR SCREEN, AND CHALKBOARD.

ALTERNATIVE INTEREST APPROACHES

ALTERNATIVE A. SURVEY THE CLASS TO DETERMINE THE ACRES OF ROW CROPS PRODUCED. ILLUSTRATE ON CHALKBOARD CHART OR BLANK TRANSPARENCY USING AN OVERHEAD PROJECTOR.

ALTERNATIVE B. SURVEY CLASS AS TO: (A) HOW MANY PLOW ALL CORN GROUND, (B) HOW MANY PLANT CORN WITHOUT PLOWING, AND (C) WHAT TILLAGE TOOL IS USED FOR PRIMARY TILLAGE. USING TRANSPARENCY #21, SHOW RANGE IN EQUIPMENT AND LABOR COST/ACRE IN PRODUCING ROW CROPS.

QUESTIONS TO BE ANSWERED

1. WHAT EFFECT DOES PLANTING DATE HAVE ON YIELD?
2. WHAT ARE SOME WAYS OF GETTING THE CROP IN AT A MORE OPPORTUNE TIME?
3. WHAT TILLAGE SYSTEMS ARE AVAILABLE AND WHAT ARE THEIR ADVANTAGES AND LIMITATIONS?
4. WHAT TILLAGE SYSTEMS ARE SUITABLE FOR YOUR PARTICULAR SOIL TYPE?
5. WHAT ARE THE YIELDS, CASH RETURNS, TIME REQUIRED, MACHINERY AND HERBICIDE COSTS FOR YOUR TILLAGE SYSTEM?
6. WHAT PROBLEMS ARE ASSOCIATED WITH REDUCED TILLAGE SYSTEMS AND HOW CAN THEY BE SUCCESSFULLY HANDLED?

LEARNING ACTIVITIES

1. WHAT EFFECT DOES PLANTING DATE HAVE ON YIELD?

SURVEY THE CLASS TO DETERMINE HOW MANY FARMERS HAD ALL THEIR CORN PLANTED BY THE OPTIMUM DATE. REFER TO THE DATE OF PLANTING CHARTS, TRANSPARENCIES #1-5. THROUGH DISCUSSION EMPHASIZE THAT A MAJOR FACTOR IN DETERMINING WHEN TO PLANT A CROP IS TO CONSIDER THE AVAILABLE DAYS SUITABLE FOR TILLAGE AND PLANTING.

2. WHAT ARE SOME WAYS OF GETTING THE CROP IN AT A MORE OPPORTUNE TIME?

POINT OUT THAT AN OPTIMUM PLANTING DATE MAY BEST BE ACCOMPLISHED BY REDUCING TIME THROUGH: (A) SPEEDING UP THE PRESENT OPERATIONS, AND (B) REDUCING THE NUMBER OF OPERATIONS.

SELECT A SPECIFIC PLANTING SITUATION. RELATE THE AVAILABLE DAYS SUITABLE FOR TILLAGE IF THE CROP IS TO BE PLANTED BY THE DESIRED DATE. NOTE THE RANGE IN DAYS AVAILABLE. CALCULATE THE TIME REQUIRED TO GET THE JOB DONE WITH CONVENTIONAL EQUIPMENT COMPARED TO TIME REQUIRED IF A REDUCED TILLAGE SYSTEM WERE TO BE USED. USE TRANSPARENCIES #5-20 TO HELP FARMERS DETERMINE THE DIFFERENCES.

3. WHAT TILLAGE SYSTEMS ARE AVAILABLE AND WHAT ARE THEIR ADVANTAGES AND LIMITATIONS?

DESCRIBE THE THREE TILLAGE SYSTEMS USED IN CROP PRODUCTION. POINT OUT THAT WITHIN EACH SYSTEM SEVERAL VARIATIONS OF THE KIND AND AMOUNT OF USE OF TILLAGE IMPLEMENTS ARE POSSIBLE. SHOW TRANSPARENCY #22 TO COMPARE COMPLETE TILLAGE AND NO-TILLAGE SYSTEMS.

DISCUSS THE REQUIREMENTS OF A SUITABLE TILLAGE SYSTEM SHOWN IN TRANSPARENCIES #23-26. USE THIS LIST TO EVALUATE THE TILLAGE SYSTEM SELECTED.

IF AVAILABLE, SHOW SLIDES 55 TO 62 OF "TILLAGE SYSTEMS....," (FREDLINE AND BONE) TO SHOW EXAMPLES OF EQUIPMENT. ALSO, USE TRANSPARENCIES #27 AND 28.

4. WHAT TILLAGE SYSTEMS ARE SUITABLE FOR YOUR PARTICULAR SOIL TYPE?

PRESENT GUIDELINES FOR TILLAGE OF THE VARIOUS SOIL TYPES USING TRANSPARENCY #22.

5. WHAT ARE THE YIELDS, CASH RETURNS, TIME REQUIRED, MACHINERY AND HERBICIDE COSTS FOR YOUR TILLAGE SYSTEM?

DISTRIBUTE HANDOUTS #1 AND 2 TO HELP FARMERS DETERMINE THE PARTICULARS OF THEIR TILLAGE SYSTEMS. THE 1974-75 OHIO AGRONOMY GUIDE WILL ALSO BE HELPFUL HERE.

6. WHAT PROBLEMS ARE ASSOCIATED WITH REDUCED TILLAGE SYSTEMS AND HOW CAN THEY BE SUCCESSFULLY HANDLED?

IN YOUR DISCUSSION, CONSIDER THE USE OF HERBICIDES, INSECT CONTROL, AND DISEASE CONTROL.

APPLICATION

1. UTILIZE SUPERVISORY VISITS TO DETERMINE THE DEGREE OF IMPLEMENTATION OF THE SELECTED TILLAGE SYSTEM ACCOMPLISHED BY CLASS MEMBERS.

2. CONDUCT TOUR OF CLASS MEMBERS' FARMS INDICATING THE TILLAGE METHODS, PLANTING DATE, ETC.

Appendix A

Content Summary

1. Date of Planting

2. Planting Time

3. Primary Tillage Implements

    A. Moldboard Plow
    B. Chisel Plow
    C. Rotary Tillers

4. Secondary Tillage Implements

    A. Disk Harrow
    B. Spring-tooth Harrow
    C. Field Cultivator
    D. Spike-tooth Harrow
    E. Cultipacker

5. Post-Planting Tillage Implements

    A. Row Cultivator
    B. Rotary Hoe
    C. Field Sprayers
    D. Planters

6. Tillage Systems

    A. Soil type
    B. Minimum Tillage
    C. Plow, Disk, or Field Cultivate and Plant
    D. Rotary Till and Plant
    E. Chisel Plow or Field Cultivate, Plant
    F. Plow, Plant, Cultivate One Time

7. No-Tillage

    A. Tool Options
    B. Soil Penetration
    C. Trash Accumulation
    D. Rocks and Other Obstructions
    E. Furrow Opener Depth Control
    F. Uniformity of Planting Depth
    G. Seed Placement
    H. Furrow Closure
    I. Component Tracking
    J. Fertilizer Application

DATE OF PLANTING

LONG-TERM STUDIES OF DATES OF PLANTING CONDUCTED AT WOOSTER, OHIO SHOW THAT THE HIGHEST CORN YIELDS HAVE BEEN OBTAINED FROM A MAY 7 DATE OF PLANTING, AND LOWER YIELDS WHEN PLANTING WAS EARLIER OR LATER. RESEARCH WORKERS STATED THAT, MOVING SOUTH FROM WOOSTER, THE SEASON CHANGES ON THE AVERAGE OF ONE DAY EARLIER FOR EACH 10 MILES. THIS INDICATES AN IDEAL PLANTING TIME FOR CORN AT PORTSMOUTH 14 DAYS EARLIER THAN AT WOOSTER. (SEE TRANSPARENCY #1)

RESULTS OF DATES OF PLANTING FOR THE PAST FIVE YEARS ARE PRESENTED IN TRANSPARENCY #2. THESE ARE THE ONLY KNOWN DATA THAT INDICATE CORN MAY BE PLANTED VERY EARLY WITHOUT ADVERSELY AFFECTING YIELD. CORN WAS PLANTED EACH WEEK WHEN SOIL CONDITIONS PERMITTED THE OPERATION OF EQUIPMENT IN THE FIELD. WHEN THE SOIL WAS TOO WET, PLANTING WAS DELAYED.

THE DATA INDICATE THAT CORN CAN BE PLANTED EARLIER THAN NORMAL AND STILL PRODUCE ADEQUATE STANDS AND YIELD. CORN YIELDS HELD AT THE 170 TO 180 BU/A LEVEL WITH PLANTING DATES FROM LATE MARCH TO MAY 10. YIELDS DECLINED RAPIDLY WHEN PLANTING WAS DONE AFTER MAY 10. MOISTURE CONTENT OF THE GRAIN INCREASED AND TEST WEIGHT DECREASED WITH LATER DATES OF PLANTING. YIELD FELL TO 97 BU/A IN THE 5-YEAR AVERAGE WHEN PLANTED IN MID-JUNE.

PLANTING TIME

SOIL AND WEATHER CONDITIONS ARE GENERALLY SUITABLE TO START PLANTING ABOUT MAY 1 IN OHIO. THE DATE OF PLANTING AFFECTS THE GROWTH PATTERN OF SOYBEANS. THE SOYBEAN PLANT HAS THREE DEVELOPMENTAL STAGES, NAMELY, VEGETATIVE GROWTH, BLOOMING, AND POD-FILL. TO OBTAIN MAXIMUM YIELDS, IT IS IMPORTANT TO GET NEAR MAXIMUM VEGETATIVE GROWTH BEFORE THE BLOOMING PERIOD STARTS. GROUP I MATURITY VARIETIES WILL START BLOOMING ON JUNE 24 IF PLANTED BEFORE MAY 25. THE EARLY GROUP IV VARIETIES WILL BEGIN BLOOMING ABOUT JULY 10 WHEN PLANTED BEFORE MAY 25, WITH GROUP II AND III VARIETIES BEING INTERMEDIATE.

THE PERIOD WHEN MOISTURE STRESS IS MOST DAMAGING TO SOYBEANS IS DURING POD-FILL (AUGUST), WHICH IS USUALLY THE PERIOD OF DRY WEATHER IN OHIO. AS SOYBEAN PLANTING IS DELAYED, THERE IS AN OVERLAPPING OF THE VEGETATIVE GROWTH STAGE WITH THE BLOSSOMING AND POD-FILL STAGES. THE COMBINATION OF DRY WEATHER AND PLANT GROWTH FACTORS PLACES THE SOYBEANS UNDER SEVERE STRESS RESULTING IN LOWER YIELDS.

WHEN RAINFALL, GROWING CONDITIONS, AND CULTURAL PRACTICES ARE IDEAL THE YIELD DIFFERENCE DUE TO PLANTING DATE FOR A GIVEN VARIETY WILL BE MUCH LESS THAN WHEN POOR GROWING CONDITIONS EXIST. OHIO RESEARCH HAS SHOWN THAT IN THE YEARS WHERE WEATHER WAS NEAR IDEAL, THE YIELD DIFFERENCE BETWEEN MAY 1 AND JUNE 1 PLANTING WAS 6 TO 11 BUSHELS PER ACRE DEPENDING UPON THE VARIETY. DURING THOSE YEARS WHERE GROWING

CONDITIONS WERE POOR, THE YIELD DIFFERENCE DUE TO PLANTING DATE RANGED FROM 9 TO 14 BUSHELS. AS A GENERAL RULE, SOYBEAN YIELDS WILL BE REDUCED 1/3 TO 1/2 BUSHEL PER ACRE PER DAY WHEN PLANTED AFTER MAY 10. THE YIELD DATA IN TRANSPARENCY #3 INDICATE THAT GROUP III MATURITY SOYBEANS HAD A SMALLER YIELD REDUCTION DUE TO DELAYED PLANTING THAN DID GROUP II VARIETIES. MUCH OF THIS DIFFERENCE IS BECAUSE THE GROUP III MATURITY SOYBEANS STARTED BLOOMING 10 TO 14 DAYS LATER THAN THE EARLY VARIETIES, PROVIDING A LONGER PERIOD FOR VEGETATIVE GROWTH BEFORE BLOOMING. (SEE TRANSPARENCIES #3-8)

PRIMARY TILLAGE IMPLEMENTS

THE PRIMARY TILLAGE OPERATION MAY PERFORM ONE OR MORE OF THE FOLLOWING OPERATIONS: BREAK THE SOD, TURN MATERIALS UNDER, MIX TRASH AND RESIDUES WITH THE SOIL, KILL WEEDS, AND BURY INSECTS OR EXPOSE THEM TO THE SUNLIGHT.

MOLDBOARD PLOW

THE MOLDBOARD PLOW IS CONSIDERED BETTER THAN ANY OTHER IMPLEMENT FOR BREAKING UP TOUGH SOD (SEE TRANSPARENCY #10). WHEN ADJUSTED AND USED PROPERLY IT DOES AN EXCELLENT JOB OF TURNING UNDER STRAW, MANURE, CORN STALKS, AND OTHER RESIDUES.

THE MOLDBOARD PLOW CUTS, LIFTS, SHEARS, AND TURNS THE FURROW SLICE. WHEN USED ON HEAVY SOILS, WHERE THE MOISTURE CONTENT IS NEITHER TOO HIGH OR TOO LOW (50 PERCENT OF FIELD CAPACITY), THESE FORCES OF CUTTING, LIFTING, SHEARING AND TURNING WILL IMPROVE THE SOIL TILTH.

SILT LOAM SOILS, OR THOSE WITH MORE CLAY CONTENT, WILL TURN UP CLODS WHEN PLOWED TOO DRY; WHEN PLOWED TOO WET THESE SOILS WILL DRY FORMING VERY HARD LUMPS.

IN AREAS WHERE HEAVY SOILS ARE PROMINENT, AS THE LACUSTRINE SOILS OF NORTHWESTERN OHIO, FALL PLOWING IS PRACTICED EXTENSIVELY. THESE HEAVY SOILS HAVE POOR NATURAL DRAINAGE, SO A TWO-FOLD PURPOSE IS OBTAINED: (1) WET SPRING WEATHER MAY DELAY PLOWING TO THE EXTENT THAT PLANTING IS DELAYED BEYOND THE OPTIMUM TIME; (2) IF THESE HEAVY SOILS ARE PLOWED WHEN EITHER TOO WET OR TOO DRY, THE FREEZING AND THAWING ACTION OF WINTER WEATHER WILL CAUSE THE HARD CLODS TO BREAK DOWN INTO DESIRABLE-SIZED GRANULES. LATE SUMMER OR EARLY FALL PLOWING IS NOT CONSIDERED ADVANTAGEOUS AS IT MAY CAUSE EROSION PROBLEMS.

SPRING PLOWING OF MEDIUM TEXTURED SOILS IS RECOMMENDED. FALL PLOWING WILL EXPOSE THE SOIL TO WEATHER ACTION, AND MAY CAUSE THE SOILS TO RUN TOGETHER TO THE EXTENT THAT THEY WILL HAVE TO BE PLOWED AGAIN IN THE SPRING. IF THESE SOILS ARE ON SLOPING LAND, EROSION MAY BECOME A SERIOUS PROBLEM.

The Chisel Plow

The chisel plow is a substitute for the moldboard plow and is coming more into use. Chisel plows are rigid-tined implements capable of penetrating to plow depth (See transparency #10). The chisel plow loosens and shatters the soil if it is not too wet. Where it is desirable to leave the residue on the soil surface as a mulch, the chisel plow has an advantage over the moldboard plow. Less time to do the primary tillage job is another advantage over the moldboard plow. When soil conditions in regard to moisture are correct, chisel plowing could be the only tillage operation needed before planting.

Rotary Tillers

Rotary tillers are designed to produce a finished seedbed in one operation (See transparency #11). The action of the spring steel hooks rotating at very high speeds breaks up the soil layer into very fine particles. On some soils this may be a disadvantage if the soil granules are destroyed. Coarser textured soils are probably better suited for rotary tiller use.

Secondary Tillage Implements

Disk Harrow

Where a good job of plowing is done the disk harrow is often the only secondary tillage implement needed to prepare a satisfactory seedbed (See transparency #12). Where a poor job of plowing is done, numerous diskings are often performed in an attempt to obtain a suitable seedbed. Repeated diskings often work the finer soil particles below the seed zone, and bring clods to the upper three inches of soil. This provides an unsatisfactory environment for seed germination.

The disk harrow cuts through the soil surface until its weight is supported by the soil causing packing. The disk harrow is a good implement to use where secondary tillage is required on freshly plowed sod and on plowed ground with loose residue. Shallow disking before plowing is sometimes used where heavy residues are present. The light disking moves the residues nearer the soil surface and thereby aids in better residue coverage when plowing is done. The disk harrow is sometimes used as a primary tillage implement in minimum or limited tillage practices. In these situations, disking could be the only tillage performed prior to planting.

The Spring-Tooth Harrow

The spring-tooth harrow is often used as a substitute for the disk harrow in soil situations where numerous stones are present. The spring-tooth harrow digs, lifts, and loosens the soil to a depth of about three

INCHES (SEE TRANSPARENCY #13). IT BREAKS SOME CLODS, MAKES THE SEEDBED FINER, LEVELS A ROUGH SURFACE, AND PULLS RESIDUE TO THE SURFACE. IT IS A GOOD IMPLEMENT TO USE FOR LOOSENING A FEW INCHES OF THE SURFACE SOIL AS IT DOES NOT COMPACT THE LOWER PART OF THE PLOW LAYER. IT IS NOT AS GOOD AS THE DISK HARROW IN USE ON HARD GROUND OR FRESHLY PLOWED SOD. IT IS NOT SATISFACTORY TO USE IN SITUATIONS WHERE LONG RESIDUES ARE PRESENT AS IT WILL DRAG THE RESIDUE TO THE SURFACE. CLOGGING OF THE HARROW THEN BECOMES A PROBLEM. LIKE THE DISK HARROW, WHEN USED IN SITUATIONS WHERE A POOR JOB OF PLOWING HAS BEEN DONE, NUMEROUS TRIPS OVER THE FIELD WITH THE SPRING-TOOTH HARROW WILL BRING CLODS TO THE SURFACE AND CAUSE THE FINER SOIL PARTICLES TO MOVE BELOW THE SEED ZONE.

THE FIELD CULTIVATOR

THE FIELD CULTIVATOR IS SOMETIMES USED AS A PRIMARY TILLAGE TOOL, AS THE ACTION IN THE SOIL IS SIMILAR TO THAT OF THE CHISEL PLOW (SEE TRANSPARENCY #14). IT DIGS, LIFTS, AND LOOSENS THE SOIL. IT PRODUCES GOOD RESULTS ON HARD OR COMPACTED GROUND AND IS OFTEN THE ONLY SECONDARY TILLAGE IMPLEMENT USED ON FALL PLOWED SOIL.

THE SPIKE-TOOTH HARROW

THE SPIKE-TOOTH HARROW SMOOTHS, FINES, AND LEVELS THE SOIL SURFACE (SEE TRANSPARENCY #15). IT IS USUALLY DRAWN BEHIND ANOTHER SECONDARY TILLAGE TOOL SUCH AS THE DISK HARROW.

THE CULTIPACKER

THE CULTIPACKER PULVERIZES CLODS, FIRMS THE UPPER 2 TO 3 INCHES OF THE SOIL, AND LEAVES THE SURFACE RIDGED (SEE TRANSPARENCY #15). IT PRESSES STONES AND HARD CLODS INTO THE SOIL. THE CULTIPACKER IS USEFUL FOR MAKING A FIRMER SEEDBED. THIS COULD BE OBJECTIONAL ON SOME SOILS AS THEY COULD CRUST OVER AFTER A RAINFALL, WHICH IN TURN WOULD PREVENT WATER INFILTRATION INTO THE SOIL.

THE CULTIPACKER IS OFTEN USED FOLLOWING BROADCAST SEEDINGS OF SMALL SEEDBED LEGUME AND GRASS SEEDS. PRESSING THE SOIL AROUND THE SMALL SEEDS GIVES MORE MOISTURE CONTACT CAUSING BETTER GERMINATION.

POST-PLANTING TILLAGE IMPLEMENTS

POST-PLANTING TILLAGE REFERS TO THE STIRRING OF THE SOIL BEFORE OR AFTER THE EMERGENCE OF YOUNG PLANTS. THIS OPERATION KILLS WEEDS, BREAKS THE SOIL CRUST, ENCOURAGES WATER INFILTRATION, AND AERATES THE SOIL. TWO OF THE MOST OFTEN USED IMPLEMENTS ARE THE ROW CULTIVATOR AND THE ROTARY HOE.

THE ROW CULTIVATOR

THE ROW CULTIVATOR PENETRATES AND STIRS THE SOIL SURFACE, BREAKING THE CRUST, AND EITHER TEARING OUT BY THE ROOTS OR COVERING WEEDS SO THAT THEY ARE KILLED (SEE TRANSPARENCY #17). WITH SOME SOIL TYPES, WHERE THE SOIL HAS A TENDENCY TO CRUST, BREAKING THIS CRUST WITH THE CULTIVATOR WILL ALLOW WATER TO MORE READILY INFILTRATE THE SOIL.

THE ROTARY HOE

THE ROTARY HOE MAY BE USED FOR WHAT IS OFTEN CALLED BLIND TILLAGE WHEN CROPS ARE JUST EMERGING OR ONLY A FEW INCHES TALL (SEE TRANSPARENCY #18). IT IS USED TO CULTIVATE AND DESTROY WEEDS AROUND YOUNG CROP PLANTS. NO ATTENTION IS GIVEN TO CROP ROWS. WHEN RAINS CAUSE A HARD CRUST TO FORM OVER THE SOIL AND HINDER THE EMERGENCE OF YOUNG SEEDLINGS, ESPECIALLY SOYBEANS, THE ROTARY HOE IS A GOOD IMPLEMENT FOR BREAKING THE CRUST. ROTARY HOES SHOULD BE USED AT FAIRLY HIGH SPEEDS. IN SOME SITUATIONS, GOOD WORK CAN BE DONE AT SPEEDS OF 10 MPH.

FIELD SPRAYERS

THE USE OF FIELD SPRAYERS FOR APPLICATION OF HERBICIDES IN CORN AND SOYBEAN PRODUCTION IS AN IMPORTANT PRACTICE (SEE TRANSPARENCY #19). LIMITED AND NO-TILLAGE OPERATIONS REQUIRE THE KILLING OF WEEDS AND PRE-CEEDING CROPS IF THE PRACTICE IS TO BE SUCCESSFUL. MOST CONVENTIONAL TILLAGE SYSTEMS INVOLVE SPRAYER USE FOR WEED CONTROL.

EFFECTIVE WEED CONTROL BY USE OF HERBICIDES APPLIED WITH A SPRAYER INVOLVES:

- SELECTION OF THE CORRECT HERBICIDE FOR THE WEED PROBLEM.

- DETERMINING THE CORRECT AMOUNT OF HERBICIDE TO BE APPLIED TO GET EFFECTIVE WEED CONTROL IN RELATION TO SOIL TEXTURE AND ORGANIC MATTER CONTENT.

- CALIBRATING THE SPRAYER TO ASSURE THAT THE CORRECT AMOUNT OF HERBICIDE WILL BE APPLIED, AND THAT IT WILL BE UNIFORMLY APPLIED OVER THE FIELD.

- APPLYING HERBICIDE AT THE CORRECT TIME TO GET THE BEST WEED CONTROL.

PLANTERS

TWO GENERAL PLANTER TYPES ARE USED FOR CORN AND SOYBEAN PRODUCTION, CONVENTIONAL AND NO-TILLAGE (SEE TRANSPARENCY #20). THE CONVENTIONAL PLANTER IS USED, AS THE NAME IMPLIES, WHERE CONVENTIONAL TILLAGE PRACTICES OF PLOWING, DISKING, AND OTHER SECONDARY TILLAGE OPERATIONS HAVE BEEN DONE.

UNDER NO-TILLAGE SITUATIONS, PLANTING IS PERFORMED WITH SPECIALIZED PLANTING EQUIPMENT. THE PLANTER MUST BE ABLE TO CUT THROUGH SOD, CORN STALKS, MANURE OR OTHER RESIDUE. IT MUST ALSO PLACE THE SEED AT THE PROPER DEPTH IN CONTACT WITH THE SOIL. FERTILIZER MUST BE PLACED, IF ROW APPLIED, BELOW AND AT THE SIDES OF THE SEED. THE SEED MUST BE COVERED AND THE SOIL COMPRESSED AROUND IT ENOUGH TO PROVIDE ADEQUATE MOISTURE FOR GERMINATION. IF HERBICIDES HAVE BEEN APPLIED BEFORE PLANTING, NO OTHER FIELD OPERATIONS SHOULD BE NEEDED PRIOR TO HARVEST. NO-TILLAGE PLANTERS ARE CAPABLE OF PERFORMING ADEQUATELY UNDER A WIDE RANGE OF SOIL CONDITIONS.

ADVERSE WEATHER CONDITIONS COMBINED WITH LARGE ACREAGES TO BE PLANTED MAY DELAY PLANTING BEYOND THE OPTIMUM DATE FOR OBTAINING THE HIGHEST YIELDS. CONSIDERATION SHOULD BE GIVEN TO THE SELECTION OF A PLANTER THAT CAN BE USED WITHIN A WIDE RANGE OF SURFACE SOIL CONDITIONS. THIS WILL ALLOW FOR MORE FLEXIBILITY IN THE TILLAGE AND PLANTING OPERATIONS. (DURING CLASS DISCUSSION OF TRANSPARENCY #21, BE SURE TO INCLUDE THE NOTES BELOW CONCERNING TILLAGE METHODS.)

T-21: COMPARISON OF ESTIMATED PRODUCTION COSTS FOR VARIOUS TILLAGE SYSTEMS

TILLAGE METHOD	SELECTED EQUIP. INVESTMENT TO PRODUCE 1000 ACRES OF CORN	SELECTED FIXED COSTS PER ACRE	SELECTED VARIABLE COSTS PER ACRE	TOTAL SELECTED COSTS PER ACRE	SAVINGS IN SELECTED TOTAL COSTS/ACRE COMPARED TO CONVENTIONAL TILLAGE
CONVENTIONAL TILLAGE[1]	$38,000	$16.00	$7.00	$23.00	
CHISEL PLOW PLANTING[2]	42,000	13.80	8.00	21.50	$1.50
PLOW PLANTING[3]	31,000	13.75	6.76	20.50	2.50
ROTARY TILLAGE PLANTING[4]	32,000	13.00	7.50	20.50	2.50
WHEEL TRACK PLANTING[5]	28,000	13.75	6.75	20.50	2.50
FIELD CULTIVATOR PLANTING[6]	32,000	13.25	6.75	20.00	3.00
TILL PLANTING[7]	28,000	13.00	6.50	19.50	3.50
NO-TILLAGE PLANTING[8]	28,000	13.00	6.00	19.00	4.00

[1] PLOWING AND SEVERAL DISKINGS ARE USED IN ADDITION, HARROWING AND DRAGGING SOMETIMES ARE PERFORMED.

[2] CHISEL PLOWING, SPRING TILLAGE TO PREPARE SEEDBED, AND PLANTING WITH A CONVENTIONAL TYPE PLANTER, USED EITHER ALONE OR AS A PART OF A TILLAGE OPERATION.

[3] PLOWING, THE PLANTING IMMEDIATELY THEREAFTER WITH AN ADAPTED PLANTER, OR PLOWING AND PLANTING IN ONE OPERATION.

[4] PREPARING A SEEDBED WITH A POWERED MACHINE WHICH PREPARES A SEEDBED FROM PREVIOUSLY UNPREPARED SOIL IN ONE OPERATION.

[5] PLANTING IN PLOWED OR CHISELED SOIL BY USING TIRE TRACKS OF THE TRACTOR OR THE PLANTER TO FIRM A STRIP TO RECEIVE SEED FROM THE PLANTER UNIT.

[6] FIELD CULTIVATOR WITH AN ATTACHED PLANTER USED IN PLOWED OR CHISELED SOIL, ON SOME SOILS, THE METHOD MAY BE USED IN UNPLOWED FIELDS.

[7] SOMETIMES CALLED "STRIP-TILL" PLANTING. CHISEL PLOW PLANTING, ROTARY TILLAGE PLANTING AND FIELD CULTIVATOR PLANTING MAY BE ADAPTED AS TILL PLANTING. STRIP-TILL PLANTING SHOULD NOT BE CONFUSED WITH NO-TILLAGE METHODS; THE TWO DIFFER CONSIDERABLY IN AMOUNT OF SOIL MANIPULATION.

[8] PLANTING THE CROP IN PREVIOUSLY UNPREPARED SOIL BY OPENING A NARROW SLOT, TRENCH, OR BAND ONLY OF SUFFICIENT WIDTH AND DEPTH TO OBTAIN PROPER SEED COVERAGE. NO OTHER SOIL PREPARATION. HERBICIDES USED TO REPLACE CULTIVATION.

TILLAGE SYSTEMS

SOIL TYPE/CONDITION

NO-TILLAGE CROPPING, OR ANY OTHER FORM OF MINIMUM TILLAGE, DOES NOT RESPOND EQUALLY ON ALL SOILS. NOR DOES CONVENTIONAL TILLAGE FOR THAT MATTER. EARLY WORK IN INDIANA LED TO THE OBSERVATION THAT MINIMUM TILLAGE WAS BETTER RECEIVED ON FINER-TEXTURED SOILS (CLAYS) THAN ON THE COARSER SANDS AND SILT LOAMS.

A TWO-YEAR TRIAL IN OHIO FAILED TO SUBSTANTIATE ANY SIGNIFICANT DIFFERENCE IN CORN YIELDS BETWEEN COARSE AND FINE SURFACE TEXTURES. HOWEVER, 10 YEARS OF MINIMUM TILLAGE EXPERIENCE HAS LED OHIO AGRONOMISTS TO RECOMMEND THE PRACTICE MORE FREELY WITH CRUSTING SOILS THAT DO NOT FRACTURE UPON DRYING. CRUSTING AND FRACTURING ARE AS MUCH A PRODUCT OF SOIL STRUCTURE AND CONDITION AS THEY ARE OF SOIL TYPE. A YEAR OR TWO OF NO-TILLAGE SHOULD THEREFORE REDUCE FRACTURING AND MAKE THE SOIL MORE RECEPTIVE TO THE PRACTICE.

A SUMMARY OF COMPARISONS OF COMPLETE TILLAGE VERSUS NO-TILLAGE ON SEVERAL OHIO SOILS APPEARS IN TRANSPARENCY #22. THERE APPEARS TO BE A

GREATER YEILD RESPONSE FROM NO-TILLAGE ON THE FINER TEXTURES. HOWEVER, MUCH OF THIS DIFFERENCE CAN ALSO BE ATTRIBUTED TO PREVIOUS CROP, PERCENT SURFACE COVER, AND PLANT POPULATION.

TWENTY-FIVE YEARS AGO IT WAS THOUGHT THAT AN IDEAL SEEDBED WAS SMOOTH, FREE OF CLODS AND RESIDUE. OBTAINING THIS TYPE OF SEEDBED REQUIRED MANY TRIPS OVER THE FIELD. SOME PROBLEMS CAUSED BY THIS TYPE OF TILLAGE SYSTEM ARE EXCESSIVE EROSION, SOIL COMPACTION, DELAY IN PLANTING DATE, AND HIGH COSTS FOR IMPLEMENT USE (SEE TRANSPARENCY #23). AT PRESENT, THE TREND IS AWAY FROM TILLAGE IMPLEMENTS ASSOCIATED WITH CONVENTIONAL TILLAGE TO THOSE USED IN MINIMUM OR LIMITED TILLAGE SITUATIONS. THIS IS SHOWN IN TRANSPARENCY #27, IN REGARD TO THE NUMBER AND KIND OF TILLAGE IMPLEMENTS MANUFACTURED IN 1960 COMPARED TO THOSE MANUFACTURED IN 1969. MORE ACREAGE FARMED BY ONE OPERATOR PROBABLY ACCOUNTS FOR PART OF THIS TREND.

THE NUMBER OF DISKINGS OR OTHER SECONDARY TILLAGE OPERATIONS DEPENDS UPON WEATHER CONDITIONS, SOIL CONDITIONS, THE FARMER'S ATTITUDE, AND THE TILLAGE IMPLEMENTS AVAILABLE FOR USE.

EXTRA COST AND TIME IS INVOLVED IN USING CONVENTIONAL-TILLAGE METHODS. OTHER FACTORS SUCH AS THE EFFECT OF TILLAGE METHODS ON PLANT GROWTH MUST ALSO BE CONSIDERED. THE SOIL COULD BE CONSIDERED THE HOME OF THE PLANT FROM GERMINATION UNTIL HARVEST. THE TILLED PART OF THE SOIL IS IN TWO PARTS: (1) SEED ZONE, AND (2) THE ROOT ZONE.

IF THE SEED IS NOT SURROUNDED BY GRANULATED MOIST SOIL PARTICLES IT WILL NOT GROW. THE SEED ZONE WILL HAVE SERVED ITS PURPOSE WHEN MOISTURE AND AIR ARE PROVIDED, THE SEED GERMINATES, AND THE ROOT SYSTEM IS PARTIALLY DEVELOPED.

THE ROOT ZONE IS THE PART OF THE SOIL THAT PROVIDES NUTRIENTS AND WATER FOR PRACTICALLY THE ENTIRE LIFE OF THE PLANT. DISKS AND SPRING-TOOTH HARROWS ARE THE MOST COMMONLY USED SECONDARY TILLAGE IMPLEMENTS. IN CLODDY SOILS, DISKS AND SPRING-TOOTH HARROWS CAUSE CLODS TO COME TO THE SURFACE AND WORK THE FINER PARTS OF THE SOIL BELOW THE SEED ZONE. THIS OFTEN HAPPENS WHEN A POOR JOB OF PLOWING IS DONE AND REPEATED TRIPS WITH SECONDARY TILLAGE IMPLEMENTS ARE THOUGHT TO BE NEEDED TO GET THE SOIL SURFACE IN A FINER CONDITION.

IF A GOOD JOB OF PLOWING HAS BEEN DONE, THEN SHALLOW SECONDARY TILLAGE WITH THE DISK OR SPRING-TOOTH HARROW WILL TEND TO KEEP MORE OF THE FINER PARTICLES IN THE SEED ZONE; ALSO, FEWER TRIPS OVER THE FIELD NEED TO BE MADE. WITH CONVENTIONAL-TILLAGE SYSTEMS, PLOWING WHEN SOIL CONDITIONS ARE CORRECT BECOMES MORE OF A PROBLEM DURING WET SPRING WEATHER AND WHEN LARGE ACREAGES ARE TO BE PLANTED.

MINIMUM TILLAGE

MINIMUM TILLAGE, SOMETIMES REFERRED TO AS LIMITED TILLAGE, REDUCES THE NUMBER OF FIELD OPERATIONS AS COMPARED TO CONVENTIONAL TILLAGE.

THUS, MINIMUM TILLAGE, RATHER THAN BEING ANY ONE GIVEN METHOD, IS REALLY A PRINCIPLE WHICH CAN BE APPLIED IN MANY DIFFERENT WAYS. THE MINIMUM TILLAGE SYSTEM SELECTED SHOULD BE BASED ON MANY FACTORS, SUCH AS, SOIL PROPERTIES, WEATHER CONDITIONS, THE CROP ROTATION USED, LABOR SUPPLY, AVAILABLE TIME, AND AVAILABLE MACHINERY. SOME COMMONLY USED MINIMUM TILLAGE SYSTEMS ARE LISTED IN TRANSPARENCY #24.

IN MOST MINIMUM TILLAGE SITUATIONS NO POST-PLANTING TILLAGE (CULTIVATION) IS USED, AND WEEDS ARE CONTROLLED BY HERBICIDES. MANY MINIMUM TILLAGE SYSTEMS INVOLVE THE USE OF ONLY ONE TILLAGE IMPLEMENT. EXAMPLES OF SINGLE TILLAGE OPERATIONS WOULD BE THE ROTARY TILLER AND THE PLOW AND PLANT METHOD. IN OTHER SITUATIONS INVOLVING HEAVY, POORLY DRAINED SOILS WITH A HIGH CLAY CONTENT MINIMUM TILLAGE MAY REQUIRE MORE OPERATIONS. FALL OR WINTER PLOWING MAY BE PRACTICED FOLLOWED BY A DISK OR FIELD CULTIVATOR IN THE SPRING BEFORE PLANTING. THIS REQUIRES THE USE OF TWO TILLAGE IMPLEMENTS BUT IS CONSIDERED A MINIMUM TILLAGE METHOD.

THE AMOUNT OF TIME AVAILABLE FOR PREPARING SOIL FOR PLANTING BY THE OPTIMUM PLANTING DATE IS A MAJOR ITEM TO CONSIDER IN SELECTING A TILLAGE SYSTEM. THIS MAY WELL VARY FROM YEAR TO YEAR DEPENDING ON WEATHER AND SOIL CONDITIONS. THE SELECTION OF A TILLAGE SYSTEM CAN BE CONSIDERED A FLEXIBLE ONE. YIELD RESULTS FROM RESEARCH STUDIES SHOULD ALSO BE USED IN MAKING A SELECTION. THE ADVANTAGES OF MINIMUM TILLAGE, AS COMPARED TO CONVENTIONAL, APPEAR IN TRANSPARENCY #24.

PLOW, DISK OR FIELD CULTIVATE AND PLANT

ON SOME SOIL TYPES YIELDS ARE HIGHER WHERE THE SOIL IS PLOWED. WHERE EROSION IS NOT A PROBLEM, FALL OR WINTER PLOWING IS DONE TO DECREASE THE AMOUNT OF TIME NEEDED FOR TILLAGE IN THE SPRING. BY PLOWING IN THE FALL OR WINTER, PLANTING CAN BE DONE EARLIER IN THE SPRING SINCE ONLY ONE TILLAGE OPERATION IS NEEDED BEFORE PLANTING. A DISK OR FIELD CULTIVATOR IS USED JUST BEFORE PLANTING. OFTEN A SPIKE-TOOTH HARROW IS PULLED BEHIND THE DISK OR FIELD CULTIVATOR TO LEVEL THE SOIL AND FILL IN AIR POCKETS.

ROTARY TILL, PLANT

POWER-DRIVEN ROTARY TILLER MACHINES CAN BE USED TO PREPARE A SEEDBED IN ONE, SOMETIMES TWO, TRIPS OVER THE FIELD. THE ROTATING BLADES LOOSEN THE SOIL, PULVERIZE IT, AND MIX THE RESIDUE IN THE TILLED SOIL LAYER.

THE ACTION OF THE ROTATING TILLER BLADES HAS A TENDENCY TO PULVERIZE SOME SOIL TYPES TOO FINELY. THIS RESULTS IN THE SOIL BECOMING QUITE LOOSE UNTIL A HEAVY RAIN WHEN IT BECOMES COMPACTED AND CRUSTED. WHEN ROTARY TILLERS ARE USED, SOILS WITH FINE TEXTURES TEND TO COMPACT AND CRUST MORE THAN COARSER TEXTURES.

CHISEL PLOW, OR FIELD CULTIVATE, PLANT

ON SOILS THAT ARE EASY TO PULVERIZE, A SEEDBED CAN BE PREPARED WITH A CHISEL PLOW OR FIELD CULTIVATOR. THIS IS THE ONLY TILLAGE OPERATION NEEDED BEFORE PLANTING. THE CHISEL PLOW OR FIELD CULTIVATOR WILL NOT PREPARE A SATISFACTORY SEEDBED IF THE SOIL MOISTURE IS TOO HIGH. CLOGGING MAY BE A PROBLEM WHERE A LARGE AMOUNT OF CORN STALKS ARE PRESENT IN A FIELD. THIS PROBLEM CAN BE OVERCOME BY USING A CHISEL PLOW WITH HIGH ARCH SHANKS. WITH A FIELD CULTIVATOR, THE SHANKS MAY HAVE TO BE SPACED FAR ENOUGH APART TO PREVENT CLOGGING OF CORN STALKS OR OTHER RESIDUE. IN SOME SITUATIONS CORN STALKS MAY HAVE TO BE DISKED OR BROKEN UP WITH A STALK BEATER AHEAD OF THE CHISEL PLOW OR FIELD CULTIVATOR.

PLOW, PLANT

THE PLOW, PLANT SYSTEM OF MINIMUM TILLAGE WAS TRIED IN THE 1950'S BUT WAS NEVER USED TO ANY EXTENT BY FARMERS. PROBABLY, THE ROUGH SURFACE WAS SO DIFFERENT FROM THE SMOOTH SURFACE OBTAINED FROM CONVENTIONAL TILLAGE THAT FARMERS NEVER ACCEPTED IT. IN THE PLOW, PLANT OPERATION, THE ONLY SEEDBED PREPARATION IS DONE BY THE PLOW. SOME TYPE OF MULCHER ATTACHMENT IS OFTEN USED ON THE PLOW TO LEVEL THE SOIL. PLOWING IS USUALLY DELAYED UNTIL JUST BEFORE PLANTING. PLANTING ON FRESHLY PLOWED SOIL PULVERIZES THE SOIL IN THE WHEEL TRACKS SO THAT LESS MOISTURE IS LOST.

PLOWING AND PLANTING IN ONE OPERATION IS DONE WITH THIS METHOD OF MINIMUM TILLAGE. IT ELIMINATES ANY SOIL PACKING FROM THE TRACTOR WHEELS AFTER PLOWING AND LEAVES THE SOIL LEVEL. SPECIAL PLANTING EQUIPMENT ADAPTED TO PULLING BEHIND THE PLOW IS NEEDED FOR THIS METHOD OF MINIMUM TILLAGE.

DISK, PLANT

WITH SOILS EASY TO PULVERIZE, DISKING CAN BE THE ONLY TILLAGE OPERATION PERFORMED PRIOR TO PLANTING. THE DISKING IS USUALLY DONE JUST BEFORE PLANTING IN ORDER TO KILL MORE WEEDS.

THE DISK, PLANT METHOD OF MINIMUM TILLAGE WOULD USUALLY BE AN EMERGENCY TILLAGE PRACTICE WHERE INCLEMENT WEATHER DELAYED THE ORIGINAL PLANNED TILLAGE OPERATION.

PLOW, PLANT, CULTIVATE ONE TIME

WITH MOST MINIMUM TILLAGE SYSTEMS NO TILLAGE IS DONE AFTER PLANTING. ON SOME SOIL TYPES THAT CRUST AFTER A RAIN, CULTIVATION BY BREAKING THE CRUST RESULTS IN BETTER WATER INTAKE.

ON SOILS THAT DO NOT CRUST, CULTIVATION IS USUALLY NOT NEEDED. IN MOST SITUATIONS WHERE CULTIVATION IS NOT DONE, HERBICIDES MUST BE USED.

NO-TILLAGE

WHEN THE NO-TILLAGE SYSTEM IS USED, THE LAND IS NOT BROKEN BY ANY TILLAGE TOOL. CHEMICAL HERBICIDES ARE APPLIED THAT WILL KILL ALL EXISTING PLANT GROWTH. THE HERBICIDES, TO BE EFFECTIVE, NEED TO KILL ALL GROWTH FROM PREVIOUS CROPS, PERENNIAL WEEDS, AND ANNUAL WEEDS THAT COULD LATER GERMINATE FROM SEEDS. THE HERBICIDE IS USUALLY APPLIED BEFORE PLANTING. A SPECIAL HEAVY-DUTY TYPE PLANTER IS USED. THIS PLANTER CUTS A VERY NARROW TRENCH INTO THE SOIL, AND BY USE OF PACKER TYPE WHEELS COVERS AND PACKS THE SOIL AROUND THE SEEDS TO INSURE GERMINATION. THE NO-TILLAGE SYSTEM IS USED ON SOD OR SOIL COVERED WITH A RESIDUE FROM A PREVIOUS CROP. SOME ADVANTAGES AND DISADVANTAGES OF THE NO-TILLAGE SYSTEM ARE NOTED IN TRANSPARENCY #25.

REQUIREMENTS FOR A PRACTICAL TILLAGE SYSTEM APPEAR IN TRANSPARENCY #26.

NO-TILLAGE TOOL OPTIONS

MOST NO-TILLAGE PLANTERS WILL PROVIDE GOOD RESULTS WHEN CONDITIONS ARE IDEAL. WHERE LESS THAN IDEAL CONDITIONS EXIST THE FOLLOWING SITUATIONS MAY NEED ATTENTION. REFER TO TRANSPARENCY #28.

SOIL PENETRATION

INADEQUATE SOIL PENETRATION IS A COMMONLY ENCOUNTERED PROBLEM. ROLLING COULTERS ARE USED IN FRONT OF EACH ROW UNIT, BUT OFTEN SUFFICIENT WEIGHT IS NOT PROVIDED TO INSURE THE NEEDED PENETRATION. FOR ADEQUATE SOIL PENETRATION, AS MUCH AS 400 POUNDS PER COULTER MAY BE REQUIRED; EVEN MORE FOR FLUTED COULTERS.

THE NO-TILLAGE PLANTER REQUIRES A HEAVIER FRAME UNIT THAN CONVENTIONAL PLANTERS IN ORDER TO WITHSTAND THE HEAVIER LOADING CONDITIONS.

TRASH ACCUMULATION

SHOW TYPE FURROW OPENERS ACCUMULATE TRASH. CHISEL BOOT FURROW OPENERS ACCUMULATE TRASH AND MOVE SUBSURFACE SOIL UP TO COVER THE SURFACE MULCH AND PROMOTE WEED GROWTH.

DOUBLE-DISK FURROW OPENERS ARE SELF-CLEANING AND DO NOT ACCUMULATE AS MUCH TRASH AS SHOE AND CHISEL TYPES. IF TRASH ACCUMULATION IS A PROBLEM, DOUBLE-DISK FURROW OPENERS FUNCTION BETTER.

ROCKS AND OTHER OBSTRUCTIONS

SHOE TYPE AND CHISEL-BOOT TYPE FURROW OPENERS NEED TO BE OPERATED AT A REDUCED SPEED IN SOILS WITH ROCKS OR OTHER OBSTRUCTIONS. DOUBLE-DISK OPENERS ARE BETTER SUITED TO SUCH CONDITIONS AS THEY WILL ROLL OVER ROCKS AND OTHER OBSTRUCTIONS.

FURROW OPENER DEPTH CONTROL

THE FURROW DEPTH IS SOMETIMES NOT UNIFORM ON PLANTERS USING THE REAR PRESS WHEEL FOR DEPTH CONTROL. DEPTH CONTROL GAUGE WHEELS MOUNTED ON EITHER SIDE OF THE FURROW OPENER WILL RESULT IN MORE UNIFORMITY OF FURROW DEPTH. DEPTH BANDS ON DOUBLE-DISK OPENERS WILL ALSO HELP TO SOLVE THE PROBLEM. WITH GAUGE WHEELS OR DEPTH BANDS, ENOUGH WEIGHT CAN BE ADDED TO THE PLANTER TO ACCOMPLISH PROPER FURROW OPENING IN HARD SOIL AREAS WITHOUT CAUSING THE FURROW TO BE TOO DEEP IN SOFT SOIL AREAS.

UNIFORMITY OF PLANTING DEPTH

WHEN PLANTING ROUGH SURFACE FIELDS WITH MULTI-ROW UNITS, THE PLANTING DEPTH MAY SOMETIMES VARY GREATLY AMONG THE ROW UNITS. PLANTERS WITH INDIVIDUALLY SUSPENDED PLANTER UNITS WILL FUNCTION BETTER UNDER THESE CONDITIONS.

SEED PLACEMENT

ERRATIC FURROW CLOSURE SOMETIMES RESULTS IN SEEDS NOT BEING SUFFICIENTLY IMBEDDED IN THE FURROW. PRESSING WITH AVAILABLE REAR PRESS WHEELS DOES NOT GUARANTEE UNIFORM SEED IMPLANTATION UNDER VARYING FIELD CONDITIONS.

A SPRING-LOADED 1" X 10" SEED FIRMING WHEEL CAN BE ATTACHED BEWEEN THE FURROW OPENER AND THE REAR PRESS WHEEL. FIRMING WHEELS ARE AVAILABLE OPTIONS FOR MOST NO-TILLAGE PLANTERS. THE SEED FIRMING WHEEL WILL PRESS THE SEED INTO FIRM CONTACT WITH THE SOIL IN THE BOTTOM OF THE FURROW.

FURROW CLOSURE

ERRATIC FURROW CLOSURE LEAVES SOME SEED UNCOVERED. THIS RETARDS GERMINATION AND LEAVES THE SEEDS VULNERABLE TO BIRD AND RODENT DAMAGE.

CHOOSE A COMBINATION OF COULTER, OPENER, AND PRESS WHEEL WHICH WILL RESULT IN A UNIFORMLY CLOSED FURROW. MOST PLANTERS, WITH OR WITHOUT SEMI-PNEUMATIC PRESS WHEEL TIRES, REQUIRE SOME LOOSENING OF THE SOIL IN THE ROW AREA FOR ADEQUATE FURROW CLOSURE. FLUTED COULTERS, NARROW SWEEPS, AND CHISELS ARE USED TO PROVIDE ENOUGH DOWN FORCE ON THE REAR PRESS WHEEL TO CLOSE THE FURROW AND PROVIDE NON-SLIPPING DRIVE TO THE SEED HOPPER, IF APPLICABLE. THIS FORCE SHOULD BE IN ADDITION TO THE DOWN FORCE REQUIREMENTS OF OTHER COMPONENTS FOR SOIL PENETRATION. YOU SHOULD BE ABLE TO ADD MORE WEIGHT TO THE PRESS WHEEL FRAME WHEN NEEDED TO OBTAIN PROPER FURROW CLOSURE.

COMPONENT TRACKING

ON HILLSIDES AND AROUND CONTOURS, NO-TILLAGE PLANTER COMPONENTS OFTEN DO NOT TRACK PROPERLY. THAT IS, THE OPENER DOES NOT FOLLOW

DIRECTLY IN THE SLIT MADE BY THE COULTER, AND THE PRESS WHEEL MISSES OR BARELY COVERS THE FURROW. THIS IS DUE TO THE RELATIVELY LARGE SPACING BETWEEN THESE UNITS ON MOST AVAILABLE PLANTERS. TRACTOR MOUNTED PLANTERS WITH HITCH STABILIZER BARS DO NOT TRACK AS WELL AS PULL TYPE PLANTERS.

IT IS BETTER TO USE PULL TYPE PLANTERS ON CURVED ROWS UNTIL PLANTERS WITH PIVOTING SUSPENSIONS AND MORE CLOSELY SPACED COMPONENTS BECOME AVAILABLE. MOUNTED PLANTERS WILL TRACK BETTER ON CURVED ROWS WITHOUT STABILIZER BARS.

FERTILIZER APPLICATION

SIDE PLACEMENT FERTILIZER ATTACHMENTS REQUIRE ADDITIONAL WEIGHT FOR SOIL PENETRATION AND THEREFORE GREATER FRAME STRENGTH. THIS INCREASES THE MACHINE COST AND MAY LIMIT THE NUMBER OF ROW UNITS WHICH CAN BE TRANSPORTED.

AN ALTERNATIVE IS TO BROADCAST THE FERTILIZER BEFORE PLANTING. RESEARCH INDICATES THAT A LIMIT OF 10 POUNDS PER ACRE (42 INCH ROWS) OF TOTAL COMBINED N AND K SHOULD BE OBSERVED TO AVOID SALT INJURY WITH ROW APPLICATIONS OF FERTILIZERS. WITH SPLIT BOOT APPLICATION AND NARROWER ROW SPACINGS, THIS RATE CAN BE INCREASED. A LIQUID FERTILIZER TANK AND MEYERING PUMP CAN REPLACE SIDE PLACEMENT ATTACHMENTS.

Appendix B

Instructional Materials

Handouts

H-1: Worksheet for Figuring Yields, Returns, Time Required, Machine and Herbicide Cost for Different Tillage Systems

H-1A: Worksheet with Example

H-2: Worksheet for Planning Flexibility into Tillage Practices

Transparencies

T-1: Effect of Date of Planting Corn on the Relative Grain Yield, Wooster 20-Year Average

T-2: The Effect of Date of Planting on the Moisture, Test Weight, and Yield of Corn Grain, Columbus

T-3: The Effect of Date of Planting on Soybean Yields, Western and Northwestern Ohio OARDC, 1970-72

T-4: Percent of Corn and Soybeans Planted by Selected Dates, Five-Year Average for Selected Localties in Ohio, 1965-70

T-5: Losses from Delay in Planting Corn

T-6: Number of Days Suitable for Spring Tillage

T-7: Days Available for Soil Fitting Operations, April 11 to May 10, Under Different Drainage Conditions, 20-Year Study, Central Ohio

T-8: Days Suitable for Field Work in April, 4-Year Period, 1967-70, Average for Selected Locations in Ohio

Primary Tillage Implements (T-9, 10, 11)

T-9: Cost and Time Required to Use Different Size Moldboard Plows

T-10: Cost and Time Required to Use Different Size Chisel Plows

T-11: Cost and Time Required to Use Rotary Tillers

Secondary Tillage Implements (T-12, 13, 14, 15, 16)

T-12: Cost and Time Required to Use Different Size Disk Harrows

T-13: Cost and Time Required to Use Different Size Spring-Tooth Harrows

T-14: Cost and Time Required to Use Different Size Field Cultivators

T-15: Cost and Time Required to Use Different Size Spike-Tooth Harrows

T-16: Cost and Time Required to Use Different Size Cultipackers

T-17: Cost and Time Required to Use Different Size Row Cultivators

T-18: Cost and Time Required to Use Two Different Size Rotary Hoes

T-19: Cost and Time Required to Use Sprayers

T-20: Cost and Time Required to Use Corn Planters

T-21: Comparison of Estimated Production Cost for Various Tillage Systems

T-22: Summary of 1960-62 Comparisons of Complete Tillage Versus No-Tillage

T-23: Conventional Tillage

T-24: Minimum Tillage

T-25: No-Tillage

T-26: Requirements for a Practical Tillage System

T-27: Number of Tillage Implements Manufactured in 1960 Compared to 1969

T-28: Tool Options for No-Tillage Planter Functions

T-29: Demonstration Plot Guidelines

Handout #1

SOIL TYPE: Name, Number, Or letter Example: Cardington-693 (from Canfield-714 Research Data)

KIND OF TILLAGE SYSTEM	YIELD AND GRAIN VALUE 10 ACRES	LOCATION AND NUMBER OF YRS. RESEARCH	PREVIOUS CROP	AMOUNT OF HERBICIDE USED AND COST/10 A.	IMPLEMENT SIZE AND COST FOR 10 ACRES	HOURS REQUIRED FOR 10 A.

Handout #1a

SOIL TYPE: Name, Number, or Letter Example: Cardington-693 (from Canfield-714 Research Data)

KIND OF TILLAGE SYSTEM	YIELD AND GRAIN VALUE 10 ACRES	LOCATION AND NUMBER OF YRS. RESEARCH	PREVIOUS CROP	AMOUNT OF HERBICIDE USED AND COST/10 A.	IMPLEMENT SIZE AND COST FOR 10 ACRES	HOURS REQUIRED FOR 10 A.
Example:						
No-tillage plant with mulch	1150 bu. $2817.50	OARDC Wooster, Ohio 6 years	Sod	Paraquat 2.5 gal. $74.38 Aatrex 2 lbs. actual ingredient $58.70 Total per 10 A. $133.08	Implement costs based on 100 acres annual use. Tractor cost based on 800 hours annual use.	
					No-tillage planter 4-row $47.90	3.00 hrs.
					Mtd. sprayer 8-row $10.60	1.50
					Total per 10 A. $58.50	

Handout #2: The purpose of this exercise is to give you an opportunity to plan flexibility into your tillage practices. Inclement weather, different soil situations, and time pressures for other farm work require different options for tillage if the crop is to be planted at the optimum date.

Using the information from Handout #1, list your tillage options for the different soil types and fields of interest to you.

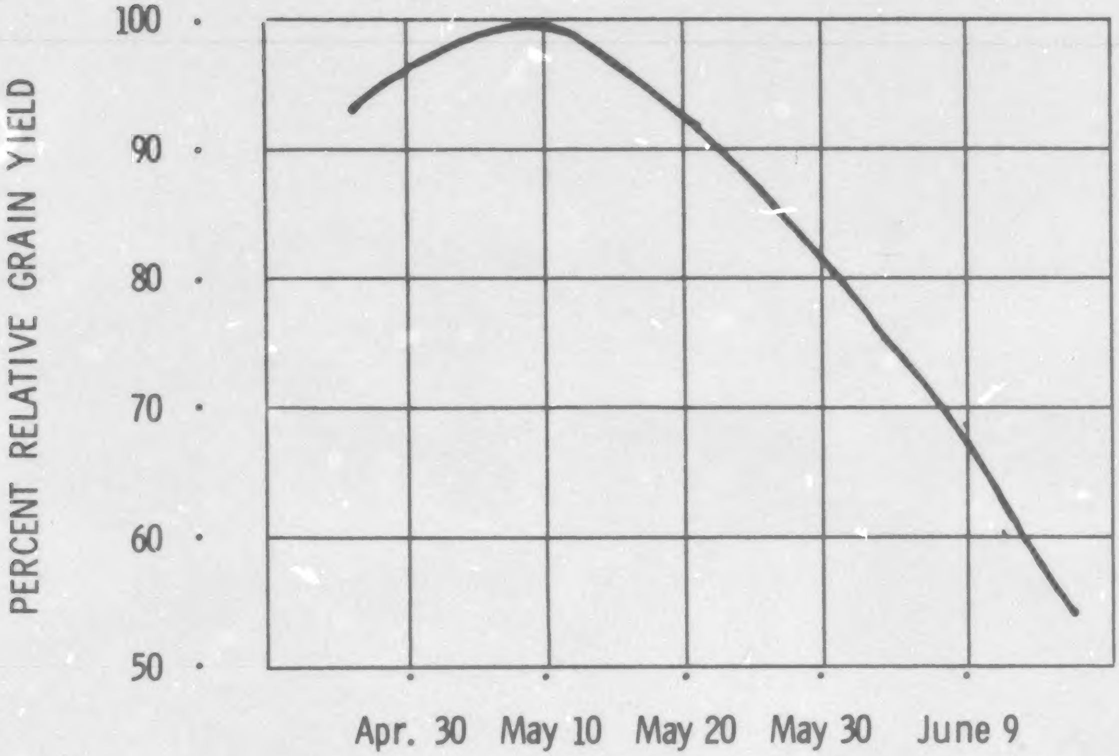
Prepare as many as will be needed.

SOIL TYPE ____________________ Field number or location on farm ____

DESCRIBE DRAINAGE ____

OPTION NUMBER	TILLAGE SYSTEM	REASONS FOR USING THIS SYSTEM

DATE OF PLANTING



T-1: Effect of Date of Planting Corn on the Relative Grain Yield, Wooster 20-Year Average. (The Ohio Agronomy Guide, 1972-73, published biennially by the Cooperative Extension Service, The Ohio State University.)

T-2: THE EFFECT OF DATE OF PLANTING ON THE MOISTURE, TEST WEIGHT, AND YIELD OF CORN GRAIN, COLUMBUS
(Pioneer Brand 3369A)

Date	Moisture	Test Wt.	Bu/A at 15½% 1969	1970	1971	1972	1973	Avg.
March 20-30	19.3	56	203	163	198	189	...	188
April 8	19.3	56	202	174	184	192	177	186
April 9-15	19.3	56	194	160	188	195	172	182
April 16-22	20.2	56	196	162	185	198	172	183
April 23-29	20.8	55	187	...	169	190	180	182
April - May 30-7	23.7	55	185	158	188	185	173	178
May 8-14	24.9	55	183	176	159	184	160	172
May 15-21	....	..	...	...	154	183	180	172
May 22-27	28.2	54	159	...	...	193	145	166
May - June 28-4	35.0	51	...	141	135	168	137	145
June 5-23	40.0	49	100	107	81	95	104	97

T-3: THE EFFECT OF DATE OF PLANTING ON YIELDS, WESTERN AND NORTHWESTERN OHIO, OARDC, 1970-72

Variety	Yields (bu/A)				Difference in
	May 1	May 10	May 20	May 30	May 1 and May 30
Harosoy 63	47.2	45.1	42.5	36.7	10.5
Beeson	51.7	47.3	43.1	40.6	11.1
Wayne	52.8	48.6	46.6	43.2	9.6
Calland	51.0	47.9	45.7	44.9	6.1
Average LSD (5%) .9 bu.	50.7	47.2	44.5	41.3	9.4

1974-75 Ohio Agronomy Guide

T-4: PERCENT OF CORN AND SOYBEANS PLANTED BY SELECTED DATES.

FIVE-YEAR AVERAGE FOR SELECTED LOCALITIES IN OHIO.

1965-70

Date	Percent Planted	
	Corn	Soybeans
May 1	5	0
May 10	20	5
May 20	45	20
May 30	75	45
June 10	95	75
June 20	1000	95

T-5: LOSSES FROM DELAY IN PLANTING CORN

Based on 150 bu. /Ac. on 100 Ac.

DATE OF PLANTING	MAY 1	MAY 10	MAY 20	MAY 30
Yield Potential 150 Bu. /Ac.	15,000	13,800	12,300	10,833
Percent Loss	0	8%	18%	30%
Yield Loss	0	1,200	2,700	4,500
Dollar Loss $3.00/Bu.	0	$3,600	$8,100	$13,500

T-6: NUMBER OF DAYS SUITABLE FOR SPRING TILLAGE

Each tillage operation requires time to accomplish and the trend is toward larger crop acreage per producer. This means that achieving the planting goal becomes increasingly difficult if several tillage operations are performed. It becomes even more critical during years of excessive rainfall, especially on poorly drained soil. Shown below are days available for spring plowing on soils with different drainage conditions on sod and stalk land. T-7 shows days available for soil fitting operations other than plowing.

As will be observed by referring to the two tables, there is a wide variation in the number of days available for spring plowing and other soil fitting operations. The number of days for spring tillage on poorly drained land in years of excessive rainfall is very limited.

DAYS AVAILABLE FOR PLOWING, MARCH 21 TO APRIL 30
UNDER DIFFERENT DRAINAGE CONDITIONS
(20-Year Study - Central Ohio)

DRAINAGE CONDITION	TOTAL DAYS	FAVORABLE DAYS AVAILABLE					
		Average for Period		Worst Year		Best Year	
		Sod	Stalk	Sod	Stalk	Sod	Stalk
Average Drainage	41	14	12	5	2	24	22
Poor Drainage	41	12	8	2	0	22	18
Good Drainage	41	17	14	6	5	27	24

Secondary tillage follows plowing. If we assume that plowing is completed by the middle of April, the number of days available for tillage operations is quite limited. See T-7. This is particularly true on poorly drained soil during years of excessive rainfall.

T-7: DAYS AVAILABLE FOR SOIL FITTING OPERATIONS, APRIL 11 TO MAY 10, UNDER DIFFERENT DRAINAGE CONDITIONS

20-Year Study - Central Ohio

DRAINAGE CONDITION	TOTAL DAYS	FAVORABLE DAYS		
		AVERAGE FOR PERIOD	WORST YEAR	BEST YEAR
Average Drainage	30	11	4	20
Poor Drainage	30	9	5	16
Good Drainage	30	13	6	21

T-8 shows additional information on the number of days suitable for tillage operations for April.

T-8: DAYS SUITABLE FOR FIELD WORK IN APRIL, 4-YEAR PERIOD, 1967-70

AVERAGE FOR SELECTED LOCATIONS IN OHIO

	1967	1968	1969	1970	AVERAGE 4-YEAR PERIOD
NUMBER OF DAYS	15	20	12	13	15

Most corn and soybean acreages are not planted in Ohio at the time when best yields are obtained. As T-4 shows, less than 50 percent of the corn acreage was planted by May 20 and less than 50 percent of the soybean acreage was planted by May 30. The data shown in T - 4 is compiled from figures for the entire state, and would be average dates. This would include later planting dates in northern Ohio and earlier planting dates in southern Ohio.

T-9. COST AND TIME REQUIRED TO USE DIFFERENT SIZE MOLDBOARD PLOWS (8- YEAR LIFE)

SIZE	TRACTOR SIZE (PLOWS)	COST PER HOUR BASED ON ACRES USED				HOURS PER ACRE
		50	100	200	300	
2 - 14 in.	2	1.95	1.10	.70	.58	1.30
3 - 14 in.	3	2.71	1.53	.97	.81	.90
4 - 14 in.	4	3.69	2.08	1.33	1.11	.58
5 - 14 in.	5	5.10	2.87	1.83	1.53	.49
2 - 16 in.	3	2.45	1.38	.88	.74	1.00
3 - 16 in.	4	3.54	1.99	1.27	1.06	.75
4 - 16 in.	5	5.17	2.91	1.86	1.55	.54
5 - 16 in.	6	6.17	3.47	2.22	1.85	.39
6 - 16 in.	6	7.36	4.14	2.65	2.21	.26

T-10: COST AND TIME REQUIRED TO USE DIFFERENT SIZE CHISEL PLOWS (8 - YEAR LIFE)

SIZE	TRACTOR SIZE (PLOWS)	COST PER HOUR BASED ON ACRES USED				HOURS PER ACRE
		50	100	200	300	
10 feet	4-5	3.88	2.18	1.39	1.17	.26
12 feet	4-5	5.17	2.91	1.86	1.55	.20
15 feet	5-6	5.61	3.16	2.02	1.69	.17
17 feet	6-7	6.15	3.47	2.22	1.85	.15

T-11: COST AND TIME REQUIRED TO USE ROTARY TILLERS (8-YEAR LIFE)

SIZE	TRACTOR SIZE (PLOWS)	COST PER HOUR BASED ON ACRES USED				HOURS PER ACRE
		50	100	200	300	
50 in.	2-3	7.20	4.05	2.59	2.16	.56
100 in.	5-6	10.71	6.03	3.86	3.22	.27

T-12: COST AND TIME REQUIRED TO USE DIFFERENT SIZE DISK HARROWS (8 - YEAR LIFE)

SIZE	TRACTOR SIZE (PLOWS)	COST PER HOUR BASED ON ACRES USED				HOURS PER ACRE
		50	100	200	300	
10 ft. light	2-3	3.46	1.94	1.24	1.03	.30
12 ft. light	3-4	4.14	2.34	1.45	1.24	.25
14 ft. light	3-4	4.88	2.75	1.75	1.46	.20
12 ft. heavy	3-4	4.58	2.58	1.65	1.37	.28
14 ft. heavy	3-4	5.06	2.85	1.82	1.52	.24
16 ft. heavy	4-5	6.14	3.46	2.21	1.84	.15
18 ft. heavy	4-5	6.88	3.87	2.47	2.06	.12
20 ft. heavy	4-5	7.82	4.40	2.81	2.35	.10

T-13: COST AND TIME REQUIRED TO USE DIFFERENT SIZE SPRING-TOOTH HARROWS (8 - YEAR LIFE)

SIZE	TRACTOR SIZE (PLOWS)	COST PER HOUR BASED ON ACRES USED				HOURS PER ACRE
		50	100	200	300	
12 feet	2-3	1.47	.84	.53	.44	.35
15 feet	3-4	1.92	1.08	.69	.58	.25
18 feet	3-4	2.27	1.28	.82	.69	.20

T-14: COST AND TIME REQUIRED TO USE DIFFERENT SIZE FIELD CULTIVATORS (8 - YEAR LIFE)

SIZE	TRACTOR SIZE (PLOWS)	COST PER HOUR BASED ON ACRES USED				HOURS PER ACRE
		50	100	200	300	
8½ ft. mounted	3-4	1.34	.75	.48	.41	.33
10½ ft. mounted	3-4	1.85	1.04	.67	.56	.26
12½ ft. mounted	4-5	1.99	1.24	.72	.60	.20
14½ ft. mounted	4-5	2.40	1.35	.86	.72	.17
10½ ft. pull type	4-5	2.31	1.30	.83	.69	.26
11½ ft. pull type	4-5	2.51	1.41	.90	.75	.22
12½ ft. pull type	4-5	2.68	1.51	.97	.81	.20
14½ ft. pull type	4-5	3.09	1.74	1.11	.93	.17
15½ ft. pull type	5-6	3.29	1.86	1.19	.99	.15
18 ft. pull type	5-6	3.42	1.92	1.23	1.03	.13

T-15: COST AND TIME REQUIRED TO USE DIFFERENT SIZE SPIKE-TOOTH HARROWS (8 - YEAR LIFE)

SIZE	TRACTOR SIZE (PLOWS)	COST PER HOUR BASED ON ACRES USED				HOURS PER ACRE
		50	100	200	300	
12 feet	2-3	.67	.37	.24	.20	.39
18 feet	3-4	.96	.54	.35	.29	.20
14 feet	3-4	1.24	.70	.45	.37	.15

T-16: COST AND TIME REQUIRED TO USE DIFFERENT SIZE CULTIPACKERS (8 - YEAR LIFE)

SIZE	TRACTOR SIZE (PLOWS)	COST PER HOUR BASED ON ACRES USED				HOURS PER ACRE
		50	100	200	300	
12 feet	2-3	3.99	2.24	1.44	1.20	.30
15 feet	2-3	4.91	2.77	1.77	1.48	.40

T-17: COST AND TIME REQUIRED TO USE DIFFERENT SIZE ROW CULTIVATORS

SIZE	TRACTOR SIZE (PLOWS)	COST PER HOUR BASED ON ACRES USED				HOURS PER ACRE
		50	100	200	300	
2-row rear mount	2	2.31	1.30	.83	.69	.50
4-row rear mount	2	4.31	2.42	1.55	1.29	.35
4-row rolling cultivator	2-3	5.40	3.04	1.94	1.62	.35
6-row rolling cultivator	2-3	6.64	3.74	2.39	2.00	.20
6-row rear mount narrow row	2-3	4.80	2.71	1.73	1.44	.20

T-18: COST AND TIME REQUIRED TO USE TWO DIFFERENT SIZE ROTARY HOES

SIZE	TRACTOR SIZE (PLOWS)	COST PER HOUR BASED ON ACRES USED				HOURS PER ACRE
		50	100	200	300	
4-row	2-3	3.51	1.98	1.26	1.06	.30
6-row	2-3	4.62	2.60	1.66	1.39	.18

T-19. COST AND TIME REQUIRED TO USE SPRAYERS

SIZE	TRACTOR SIZE (PLOWS)	COST PER HOUR BASED ON ACRES USED				HOURS PER ACRE
		50	100	200	300	
Sprayer mounted 8 row, 200 gal.	2-3	1.77	1.06	.71	.59	.15
Sprayer trailer 8 row, 300 gal.	2-3	2.57	1.51	.98	.80	.15

T-20: COST AND TIME REQUIRED TO USE CORN PLANTERS*

SIZE	TRACTOR SIZE (PLOWS)	COST PER HOUR BASED ON ACRES USED				HOURS PER ACRE
		50	100	200	300	
2-row conventional	2-3	2.60	1.55	1.13	.94	.70
4-row conventional	2-3	5.69	3.39	2.47	2.05	.30
2-row no-tillage	2-3	4.02	2.39	1.75	1.45	.70
4-row no-tillage	3-4	8.05	4.79	3.49	2.90	.30

*Includes complete unit with fertilizer and insecticide/herbicide attachments.

T-21: COMPARISON OF ESTIMATED PRODUCTION COST FOR VARIOUS TILLAGE SYSTEMS

Tillage Method	Selected equip. investment to produce 1000 Acres of Corn	Selected fixed costs per acre	Selected variable costs per acre	Total selected costs per acre	Savings in selected total costs/acre compared to conven. tillage
Conventional Tillage	$38,000	$16.00	$7.00	$23.00	0
Chisel Plow Planting	42,000	13.80	8.00	21.50	$1.50
Plow Planting	31,000	13.75	6.76	20.50	2.50
Rotary Tillage Planting	32,000	13.00	7.50	20.50	2.50
Wheel Track Planting	28,000	13.75	6.75	20.50	2.50
Field Cultivator Planting	32,000	13.25	6.75	20.00	3.00
Till Planting	28,000	13.00	6.50	19.50	3.50
No-Tillage Planting	28,000	13.00	6.00	19.00	4.00

T-22: SUMMARY OF 1960-62 COMPARISONS OF COMPLETE TILLAGE (PLOW, DISK, CULTIVATOR) VERSUS NO-TILLAGE

Soil type	Previous crop	Surface cover, per cent	Mean corn stand in thousands per acre		Mean grain yield in bushels per acre	
			Complete tillage	No-tillage	Complete tillage	No-tillage
Wooster silt loam	corn	0	18.0	18.0	106	83
Wooster silt loam	corn	0	18.0	18.0	140	127
Wooster silt loam	corn	0	19.3	16.2	70	64
Crosby silt loam	barley	5	17.2	17.2	142	134
Wooster silt loam	corn	40	18.0	18.0	85	69
Meigs silt loam	corn	50	13.2	12.9	94	113
Ravenna silt loam	sod	50-60	16.4	14.2	87	74
Meigs silt loam	corn	60	16.2	16.4	139	160
Cranfield silt loam	sod	50-60	22.2	16.7	138	132
Megis silt loam	sod	60-70	14.2	15.6	124	128
Wooster silt loam	corn	70	19.8	16.0	112	109
Wooster silt loam	corn	70	24.1	17.0	71	73
Wooster silt loam	wheat	70-80	22.1	18.0	85	72
Wooster silt loam	corn	90	19.3	15.2	70	85
Wooster silt loam	sod	100	18.0	18.0	80	110
Canfield silt loam	sod	100	20.7	20.5	83	99
Hoytville silt clay loam	corn	0	11.0	10.9	80	84
Upshur clay	sod	40	16.6	15.6	107	119
Hoytville silt clay loam	sod	40-50	13.1	12.4	107	98
Hoytville silt clay loam	corn	50	17.1	16.3	79	81
Hoytville silt clay loam	sod	60	16.9	15.9	86	84
Toledo clay	sod	75	14.0	14.3	77	85
Toledo clay	sod	75	16.3	19.1	93	100
		Mean	17.5	16.2	98.0	99.2

T-23: Conventional Tillage

Conventional tillage, sometimes referred to as maximum tillage, involves the use of several tillage implements. Conventional tillage, under maximum usage, could include the following:

1. Plowing
2. Disking twice
3. Harrow one or two times
4. Plant using a conventional planter
5. Cultivate, use harrow or rotary hoe once, and row cultivator once
6. Spray with herbicide once

T-24: Minimum Tillage

Some commonly used minimum tillage systems are:

1. Plow, disk or field cultivate, plant
2. Rotary till, plant
3. Chisel plow or field cultivate, plant
4. Plow, plant
5. Disc, plant
6. Plow, plant, cultivate one time

Minimum tillage, as compared to conventional, offers the following advantages:

1. Less costly
2. Less time required
3. Less soil compaction:
    a. From fewer trips over the soil with heavy implements
    b. From breaking the soil into particles that are too small
4. Less erosion on many soil situations

T-25: No-Tillage

Some advantages of the no-tillage system are:

1. More water is retained in the soil for use by the crop.
2. Less erosion except on bare soil.
3. Planting can be done earlier in the spring.
4. Less time and less cost in establishing a crop as no plowing, disking, harrowing or cultivation is done.
5. Fewer trips over the field reduces soil compaction.
6. On some soil situations yield, as compared with other tillage systems, has been outstanding.

Some disadvantages are:

1. Special no-tillage type corn planters are needed.
2. Difficult to incorporate residues, manure, fertilizer, lime or pesticides into the soil.
3. Different insect and disease problems may be encountered than with conventional or minimum tillage systems.
4. On sod land used for no-tillage, special herbicides must be used to kill existing vegetation. This is more costly.
5. On some soil situations, present research results shows that no-tillage does not respond in yields as compared with other tillage systems.

T-26: Requirements For A Practical Tillage System

1. Allow for early planting.

2. Result in desired plant populations.

3. Enable maximum use of water by plants.

4. Control weeds.

5. Control insects and diseases.

6. Be flexible to allow for poor weather conditions.

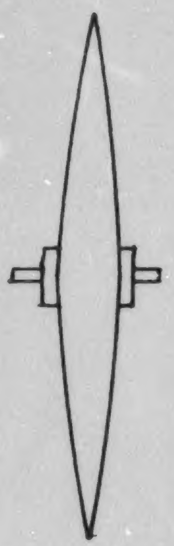
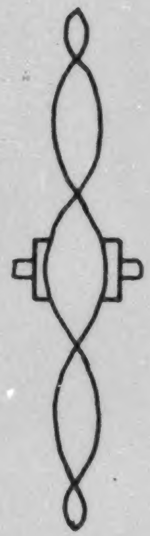
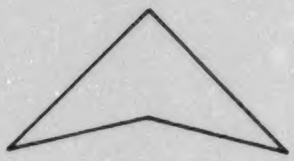
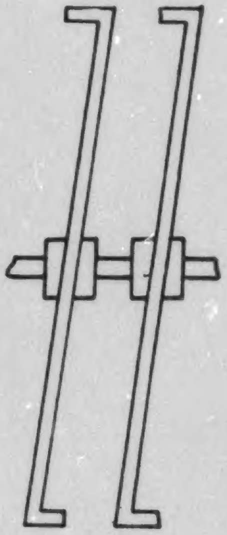
7. Be economical.

Using the above as criteria for evaluation, the selection of a tillage system for your own situation should be more practical.

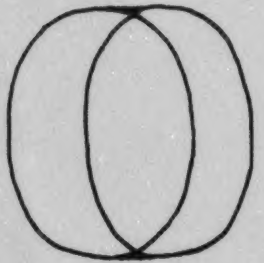
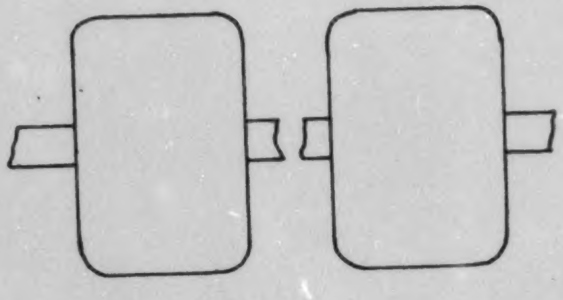
T-27: Number of Tillage Implements Manufactured in 1960 Compared to 1969

Implement	Number Manufactured	
	1960	1969
Moldboard Plows	94,021	42,818
Chisel Plows	4,371	20,141
Field Cultivators	15,426	22,583
Row-crop Cultivators	63,060	34,628

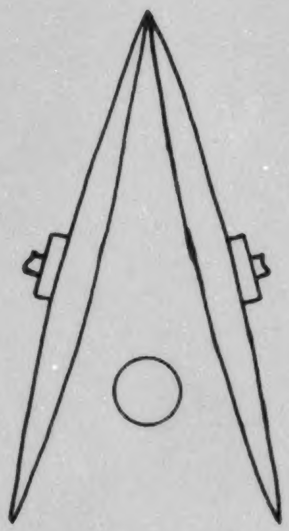
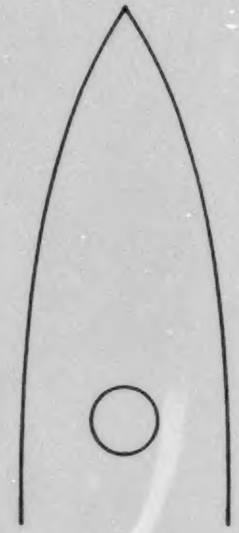
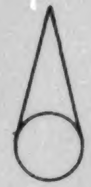
T-28: TOOL OPTIONS FOR NO-TILLAGE PLANTER FUNCTIONS

Initial Penetration for Row Seedbed Preparation	 Smooth Coulter  Fluted Coulter  Sweep  Rotary Tiller

TOOL OPTIONS FOR NO-TILLAGE PLANTER FUNCTIONS

Depth Control	 Depth Bands for Double-Disk Opener  Gauge Wheels

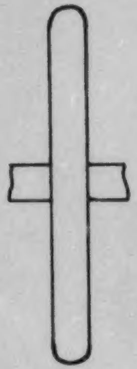
TOOL OPTIONS FOR NO-TILLAGE PLANTER FUNCTIONS

Furrow Opening & Seed Placement	 Double-Disk Opener  Shoe-Type Opener (with seed tubes)  Chisel-Boot Opener

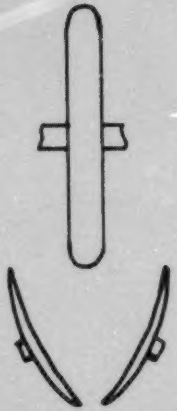
T-28b

TOOL OPTIONS FOR NO-TILLAGE PLANTER FUNCTIONS

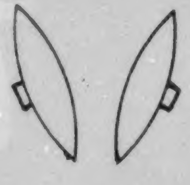
Seed Imbedding



Seed Press Wheel



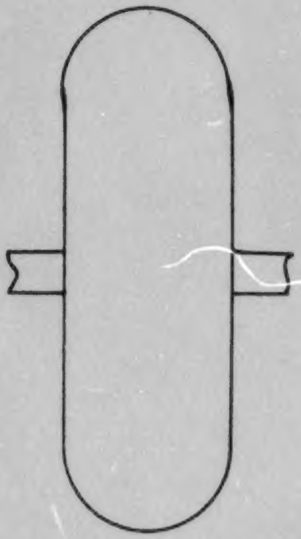
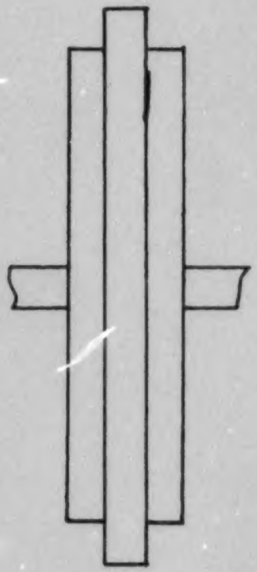
Seed Press Wheel With Disk Coverer



Disk Coverer

T-28c

TOOL OPTIONS FOR NO-TILLAGE PLANTER FUNCTIONS

Furrow Closure	 Rear Press Wheel	 Rear Press Wheel with Seed Firming Rib

T-28d

T-29. DEMONSTRATION PLOT GUIDELINES

Each tillage system should receive the same treatment in regard to the following:

1. All tillage systems compared should be on the same soil type; droughty or wet areas in a field should be avoided.
2. The previous crop should be the same for all tillage systems compared.
3. Manure, fertilizer, and lime application should be the same.
4. Planting time should be the same.
5. Kind and amount of herbicide applications may be different, depending on the tillage systems compared and the previous crop.
6. Yield checks should be made at the same time.
7. Careful records should be kept of all activities.

Adult Units No. 8, 9, 10, 11

SERVICING THE HYDRAULIC SYSTEM

A Series of Resource Units For Adult Education
Classes in Agriculture

Developed by
Wayne Longbrake

Edited by
L. H. Newcomb

Department of Agricultural Education
College of Agriculture and Home Economics
The Ohio State University
Columbus, Ohio 43210

1975

PREFACE

THESE RESOURCE UNITS WERE DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U.S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN
ASSISTANT PROFESSOR

L. H. NEWCOMB
ASSISTANT PROFESSOR

TABLE OF CONTENTS

	Page
Preface	III
Introduction	1
National and State Situation	3
Local Situation (note to teacher)	3
Objectives	3
References	4
Needed AV Equipment	4
Alternative Interest Approaches	4
Unit 8: Basic Principles of Hydraulics	6
Unit 9: Hydraulic Fluids and Filters	7
Unit 10: Maintenance Problems and Procedures	9
Unit 11: Troubleshooting the Hydraulic System	10
To Summarize (note to teacher)	11
Application	11
Appendix A: Content Summary	12
Appendix B: Instructional Materials	24

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATIBLE TO THE LOCAL COMMUNITY.

SERVICING THE HYDRAULIC SYSTEM

National and State Situation

Preventative maintenance of the hydraulic system on farm machinery is often neglected. In place of such maintenance, farmers tend to repair their machinery when it breaks down. With today's high machinery costs, critical production schedules, high "downtime" costs and variable weather conditions, farm operators can ill-afford to continue to operate in this manner. However, there is strong evidence that many farmers continue to neglect maintenance. Service representatives identify frequent malfunction problems as being caused by:

-- Insufficient oil in the reservoir

-- Clogged and dirty oil filter

-- Loose intake lines

-- Pump shaft turning in the wrong direction

-- Improper grades of oil

-- Operating pressures set too high or too low

Obviously all of these problems can be solved with a basic knowledge of hydraulic principles and good maintenance procedures. The expense and time of establishing and following a planned maintenance program will be returned many times through reduced operating costs and savings in reduced machine downtime.

A properly serviced hydraulic system will be more economical because of its longer service life and less downtime. It has been estimated that approximately 70% of all hydraulic failures are related directly to the fluid. It is important to keep the fluid clean, maintain proper fluid level, and change the fluid regularly.

Local Situation (Note to Teacher)

Visit several machinery dealerships in your area to determine the major cause of hydraulic failures in your area, and amount of machine downtime that may have been prevented through a well-planned maintenance program. Perhaps a survey of the adult farmers prior to instruction or at the beginning of the class may help provide a good picture of the local situation. It is suggested that these problems be listed on the chalkboard or on a blank transparency.

Objectives

The learner is to:

1. CORRECTLY TROUBLESHOOT A GIVEN MALADJUSTED HYDRAULIC SYSTEM AND REPAIR THE SYSTEM ACCORDING TO THE DIRECTIONS GIVEN IN THE SERVICE MANUAL.

2. PERFORM APPROVED MAINTENANCE PROCEDURES ON A MOBILE HYDRAULIC SYSTEM ACCORDING TO THE MANUFACTURER'S SERVICE MANUAL.

3. DEVELOP A STANDARD SYSTEM OF RECORDING MAINTENANCE INFORMATION. (SEE HANDOUT NO. 4)

4. IMPLEMENT AN APPROVED PROCEDURE OF DIAGNOSIS AND TESTING.

REFERENCES

ATLAND, GEORGE. PRACTICAL HYDRAULICS. TROY, MICHIGAN: VICKERS INCORPORATED, DIVISION OF SPERRY RAND CORPORATION, N.D.

BASIC PRINCIPLES OF HYDRAULICS. BIRMINGHAM, MICHIGAN: TRACTOR AND IMPLEMENT OPERATIONS, U. S. FORD TRACTOR DIVISION, FORD MOTOR COMPANY, 1963.

FUNDAMENTALS OF SERVICE - HYDRAULICS. MOLINE, ILLINOIS: DEERE AND COMPANY. SECOND EDITION, 1972.

HYDRAULIC FUNDAMENTALS AND INDUSTRIAL HYDRAULIC OILS. COLUMBUS, OHIO: SUN OIL TECHNICAL BULLETIN B-4, 1963.

HYDRAULICS CARE AND OPERATION. ATHENS, GEORGIA: AMERICAN ASSOCIATION FOR VOCATIONAL INSTRUCTIONAL MATERIALS, 1974.

INDUSTRIAL HYDRAULICS MANUAL. DETROIT, MICHIGAN: VICKERS, INCORPORATED. VICKERS CORPORATION, 1959.

MOBILE HYDRAULICS MANUAL. TROY, MICHIGAN: SPERRY RAND CORPORATION. VICKERS MOBILE HYDRAULICS DIVISION, 1967.

OPERATION AND CARE OF HYDRAULIC MACHINERY. COLUMBUS, OHIO: TEXACO, INC., 1962.

NEEDED AV EQUIPMENT

SLIDE PROJECTOR, OVERHEAD PROJECTOR, HYDRAULIC CYLINDER, CONTROL VALVE, FITTINGS AND LINES, OIL FILTERS, TRACTOR WITH THREE-POINT HITCH, COMBINE, BACKHOE AND LOADER, SMALL CLEAR BOTTLES, AND MICROSCOPE.

ALTERNATIVE INTEREST APPROACHES

ALTERNATIVE A. SURVEY THE CLASS AND LIST ON THE CHALKBOARD PROBLEMS MEMBERS HAVE WITH THEIR HYDRAULIC SYSTEMS. ESTIMATE THE CAUSE OF THE PROBLEM, AMOUNT OF DOWNTIME, AND COST OF REPAIRS.

(CHALKBOARD CHART)

PROBLEM	CAUSE	DOWNTIME	COST OF REPAIR	TOTAL COST
1.				
2.				
3.				

ALTERNATIVE B. WHAT ARE THE CRITICAL ITEMS IN THE LIFE OF A HYDRAULIC SYSTEM? (NOTE TO TEACHER: BEFORE TEACHING THIS UNIT YOU MAY WANT TO SURVEY FARM TRACTORS IN YOUR COMMUNITY REGARDING FLUID AND FILTER CHANGES. PRESENT THE INFORMATION YOU GATHERED LOCALLY AND RELATE IT TO THE CLASS MEMBERS' SITUATIONS.)

A STUDY CONDUCTED BY THE UNIVERSITY OF ILLINOIS SHOWED THAT ONLY 2 OR 49 TRACTORS HAD HYDRAULIC FLUID CHANGES MORE THAN ONCE A YEAR. THE FLUID WAS CHANGED EVERY ONE TO TWO YEARS ON 17 TRACTORS. THIRTY NEVER CHANGED THE FLUID.

ALTERNATIVE C. WHAT BASIC HYDRAULIC PRINCIPLES ARE USED WHEN YOU PUSH DOWN THE BRAKE PEDAL? (NOTE TO TEACHER: BEFORE USING THIS APPROACH DETERMINE IF THE TRACTORS IN YOUR AREA HAVE HYDRAULIC BRAKES.)

BY PUSHING DOWN ON THE BRAKE PEDAL THE FLUID IS FORCED FROM THE MASTER CYLINDER THROUGH THE LINES TO THE WHEEL CYLINDER. THE FLUID FORCES THE PISTONS IN THE WHEEL CYLINDER TO MOVE OUT AND FORCE THE BRAKE SHOES AGAINST THE BRAKE DRUM, THEREBY STOPPING THE WHEEL.[1]

---

[1] HYDRAULIC FUNDAMENTALS AND INDUSTRIAL HYDRAULIC OILS. COLUMBUS, OHIO: SUN OIL TECHNICAL BULLETIN B-4, 1963.

UNIT 8: BASIC PRINCIPLES OF HYDRAULICS

QUESTIONS TO BE ANSWERED

1. WHAT ARE THE BASIC PRINCIPLES OF HYDRAULICS?
2. WHAT ARE THE BASIC COMPONENTS OF A HYDRAULIC SYSTEM?
3. WHAT ARE THE TYPES OF HYDRAULIC CYLINDERS, OPERATING PRINCIPLES, AND REPAIR PROCEDURES?

LEARNING ACTIVITIES

1. WHAT ARE THE BASIC PRINCIPLES OF HYDRAULICS?

USE TRANSPARENCIES #1-4 TO ILLUSTRATE THE APPLIED PRINCIPLES OF HYDRAULICS.

USE FOS SLIDES #3, 4, 5, AND 6 TO POINT OUT THE APPLIED PRINCIPLES OF HYDRAULICS.

2. WHAT ARE THE BASIC COMPONENTS OF A HYDRAULIC SYSTEM?

USE TRANSPARENCIES #5-8 TO EXPLAIN THE BASIC HYDRAULIC SYSTEM.

SHOW FOS SLIDES #7, 8, AND 9 TO EXPLAIN THE BASIC HYDRAULIC SYSTEM.

USE TRANSPARENCY #9 ALONG WITH HANDOUT #1, "HYDRAULIC FACTS," TO HELP PARTICIPANTS UNDERSTAND HYDRAULICS.

3. WHAT ARE THE TYPES OF HYDRAULIC CYLINDERS, OPERATING PRINCIPLES, AND REPAIR PROCEDURES?

USE FOS SLIDES #83-90, 94, AND 95 TO DISCUSS OPERATING PRINCIPLES AND REPAIR PROCEDURES.

PREPARE A DEMONSTRATION TO SHOW DISASSEMBLY AND ASSEMBLY PROCEDURE OF CYLINDER REPAIR.

HAVE CLASS MEMBERS IN THE LABORATORY REPAIR CYLINDERS AND TRACE THE OIL FLOW THROUGH THE CYLINDERS.

USE TRANSPARENCIES #10-13 TO DISCUSS OPERATING PRINCIPLES.

QUESTIONS TO BE ANSWERED

4. WHAT ARE THE TYPES OF FILTERING SYSTEMS USED IN HYDRAULIC SYSTEMS?

5. WHAT ARE THE TYPES OF HYDRAULIC FILTERS?

6. WHAT ARE THE SIGNIFICANT PROPERTIES OF HYDRAULIC FLUIDS?

7. WHAT IS OIL CONTAMINATION AND HOW DOES IT OCCUR?

8. WHAT ARE THE EFFECTS OF CONTAMINATION?

LEARNING ACTIVITIES

4. WHAT ARE THE TYPES OF FILTERING SYSTEMS USED IN HYDRAULIC SYSTEMS?

USE TRANSPARENCY #14 TO ILLUSTRATE THE FULL-FLOW AND BY-PASS FILTERING SYSTEMS.

EXPLAIN THE FLOW OF FLUID FROM THE PUMP THROUGH THE FILTER TO THE CYLINDER.

5. WHAT ARE THE TYPES OF HYDRAULIC FILTERS?

SHOW FOS SLIDES #121-125 WHICH INCLUDE SURFACE AND DEPTH FILTERS.

PREPARE A DISPLAY OF THE VARIOUS SURFACE AND DEPTH FILTERS. EXPOSE CROSS-SECTIONS OF EACH FILTER TO SHOW THE FILTERING PROCESS.

6. WHAT ARE THE SIGNIFICANT PROPERTIES OF HYDRAULIC FLUIDS?

USE TRANSPARENCY #15 TO DISCUSS THE PROPERTIES OF HYDRAULIC FLUIDS.

7. WHAT IS OIL CONTAMINATION AND HOW DOES IT OCCUR?

PREPARE SMALL BOTTLES OF HYDRAULIC FLUID CONTAINING THE FOLLOWING CONTAMINANTS:

- WATER AND ACID IN ONE BOTTLE
- METAL BURRS AND CHIPS IN ONE BOTTLE
- DUST AND SAND IN ONE BOTTLE
- PIECES OF SEALS AND PAINT IN ONE BOTTLE
- LINT AND OTHER FIBERS IN ONE BOTTLE

PREPARE SAMPLES OF CONTAMINATION TO BE VIEWED UNDER A MICROSCOPE.

USE TRANSPARENCY #16 TO DISCUSS OIL CONTAMINANTS.

8. WHAT ARE THE EFFECTS OF CONTAMINATION?

SECURE FROM LOCAL MACHINERY DEALERS REPLACED HYDRAULIC PARTS EXEMPLIFYING DAMAGE BY FLUID CONTAMINATION. IDENTIFY THE PART BY NAME AND ITS LOCATION IN THE SYSTEM; GIVE THE OPERATIONAL FUNCTION, THE SYMPTO OF MALFUNCTIONING, AND THE TYPE OF CONTAMINATION CAUSING THE DAMAGE.

FOS HAS A SERIES OF SLIDES SHOWING DAMAGE BY CONTAMINATION.

USE TRANSPARENCY #17 TO DISCUSS THE EFFECTS OF CONTAMINATION.

UNIT 10: MAINTENANCE PROBLEMS AND PROCEDURES

QUESTIONS TO BE ANSWERED

9. WHAT ARE THE MAJOR MAINTENANCE PROBLEMS OF HYDRAULIC SYSTEMS?

11. WHAT ARE THE MAINTENANCE PROCEDURES THAT WILL KEEP THE HYDRAULIC SYSTEM IN TOP OPERATING CONDITION?

LEARNING ACTIVITIES

9. WHAT ARE THE MAJOR MAINTENANCE PROBLEMS OF HYDRAULIC SYSTEMS?

USE TRANSPARENCIES #18-19 TO POINT OUT THESE PROBLEMS.

11. WHAT ARE THE MAINTENANCE PROCEDURES THAT WILL KEEP AN ENTIRE HYDRAULIC SYSTEM IN TOP OPERATING CONDITION?

CLASS MEMBERS ARE TO PERFORM MAINTENANCE ON THEIR OWN EQUIPMENT ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.

CLASS MEMBERS RECORD NECESSARY INFORMATION ON HANDOUT #4, "MAINTENANCE RECORD."

UNIT 11: TROUBLESHOOTING THE HYDRAULIC SYSTEM

QUESTIONS TO BE ANSWERED

10. WHAT SAFETY RULES APPLY WHEN WORKING ON A HYDRAULIC SYSTEM?

12. WHAT IS THE CORRECT PROCEDURE TO FOLLOW FOR TROUBLESHOOTING A HYDRAULIC SYSTEM?

LEARNING ACTIVITIES

10. WHAT SAFETY RULES SHOULD BE FOLLOWED WHEN WORKING ON A HYDRAULIC SYSTEM?

DISTRIBUTE HANDOUT #2, "SAFETY RULES FOR HYDRAULICS." (PREPARE A DEMONSTRATION USING A BACKHOE TO ILLUSTRATE THE CORRECT APPLICATION OF EACH SAFETY RULE AS LISTED ON HANDOUT #2.) HAVE FARMERS CORRECTLY DEMONSTRATE THESE SAFETY RULES WHILE SERVICING THEIR OWN EQUIPMENT.

USE TRANSPARENCY #20 TO FURTHER DISCUSS HYDRAULIC SAFETY RULES.

12. WHAT IS THE CORRECT PROCEDURE TO FOLLOW FOR TROUBLESHOOTING A HYDRAULIC SYSTEM?

PROVIDE THE CLASS WITH HANDOUT #3, "TROUBLESHOOTING GUIDE."

PREPARE A BACKHOE AND LOADER WITH PREDETERMINED MALFUNCTIONS AND HAVE CLASS MEMBERS TROUBLESHOOT THE SYSTEM. CLASS MEMBERS SHOULD PROPERLY FILL OUT THE SERVICE CHART AND SERVICE THE SYSTEM ACCORDING TO MANUFACTURER'S SPECIFICATIONS.

USE TRANSPARENCIES #21-22 TO DISCUSS THE CORRECT PROCEDURE FOR TROUBLESHOOTING.

TO SUMMARIZE (NOTE TO TEACHER)

THE INSTRUCTOR SHOULD HAVE THE FOLLOWING MATERIALS AVAILABLE BEFORE BEGINNING THE UNIT:

1. EACH CLASS MEMBER NEEDS ONE PIECE OF EQUIPMENT TO SERVICE IN THE LABORATORY. IF CLASS MEMBERS ARE UNABLE TO PROVIDE EQUIPMENT, SOLICIT THE MACHINERY DEALERS FOR EQUIPMENT.

2. SERVICE MANUALS FOR INDIVIDUAL EQUIPMENT MUST BE AVAILABLE. IF OWNERS CANNOT PROVIDE SERVICE MANUALS, YOU MAY BORROW THEM FROM MACHINERY DEALERS.

3. FUNDAMENTALS OF SERVICE - HYDRAULIC SLIDE SET. DEERE AND COMPANY, MOLINE, ILLINOIS. SLIDES MAY BE OBTAINED THROUGH THE OHIO CURRICULUM MATERIALS SERVICE.

4. TRANSPARENCIES CONTAINED IN THE UNIT CORRESPOND WITH THE FOS SLIDE SERIES. IT IS SUGGESTED TO USE EITHER ONE TO SUPPLEMENT THE LESSON, BUT NOT BOTH.

5. I AND T MANUAL SET MAY BE OBTAINED FROM:

   IMPLEMENT AND TRACTOR
   WYANDOTT STREET
   KANSAS CITY, MISSOURI

6. DO NOT SPEND TOO MUCH TIME ON QUESTIONS TO BE ANSWERED, 1-10. QUESTIONS 11 AND 12 ARE THE OUTCOMES THAT YOUNG FARMERS WANT AND CONSIDERABLE EFFORT SHOULD BE DEVOTED TO THIS AREA OF THE UNIT.

APPLICATION

EVALUATE THROUGH A SUPERVISORY VISIT TO SEE IF THE FOLLOWING APPROVED PRACTICES ARE BEING USED:

1. THE CLASS MEMBERS MAINTAIN AN ACCURATE MAINTENANCE RECORD.
2. THE CLASS MEMBERS DEVELOP AND USE A PLANNED SERVICE PROGRAM.
3. THE CLASS MEMBERS RECORD SYMPTOMS OF HYDRAULIC MALFUNCTIONING.
4. CLASS MEMBERS DEMONSTRATE TROUBLESHOOTING PROCEDURE.
5. CLASS MEMBERS PRECISELY DESCRIBE CORRECTIVE ACTION TAKEN.
6. REPAIRS MADE ARE EXPLAINED AND COSTS ARE RECORDED.
7. THE CLASS MEMBERS RECORD LENGTH OF DOWNTIME.

APPENDIX A

CONTENT SUMMARY

1. BASIC PRINCIPLES OF HYDRAULICS
2. HYDRAULIC CONTROL VALVES
    - A. PRESSURE CONTROL VALVES
    - B. DIRECTIONAL CONTROL VALVES
    - C. VOLUME CONTROL VALVES
    - D. CYLINDERS
3. HYDRAULIC FILTERING SYSTEMS
    - A. FILTER ELEMENTS
4. HYDRAULIC FLUID PROPERTIES
5. DIAGNOSIS AND TESTING OF HYDRAULIC SYSTEMS

BASIC PRINCIPLES OF HYDRAULICS[1]

HYDRAULICS, AS USED IN THE AGRICULTURE INDUSTRY TODAY, IS THE SCIENCE OF TRANSMITTING FORCE AND/OR MOTION THROUGH A CONFINED FLUID. THE BASIC PRINCIPLES OF HYDRAULICS CAN BE EASILY UNDERSTOOD. HYDRAULIC FLUID IS THE MOST FLEXIBLE MEDIUM OF TRANSMITTING POWER PROVIDED BY MODERN TECHNOLOGY, AND IT IS AS UNYIELDING IN STRENGTH AS STEEL. A FLUID CAN READILY CHANGE ITS SHAPE TO ALLOW FLOW IN ANY DIRECTION AND THROUGH PASSAGES OF VARIOUS SIZES AND SHAPES. THUS, THE FIRST TWO PRINCIPLES OF HYDRAULICS ARE: (1) LIQUIDS HAVE NO SHAPE OF THEIR OWN. THEY ACQUIRE THE SHAPE OF THEIR CONTAINER; AND (2) LIQUIDS CANNOT BE COMPRESSED TO OCCUPY LESS SPACE. LIQUIDS DO COMPRESS SLIGHTLY WHEN PLACED UNDER HIGH PRESSURE BUT FOR THE PURPOSES OF THIS DISCUSSION THEY ARE TO BE CONSIDERED INCOMPRESSIBLE.

TO DEMONSTRATE THE THIRD PRINCIPLE OF HYDRAULICS, TWO HYDRAULIC CYLINDERS OF EQUAL PISTON AREA (2 SQ. INS.) MUST BE USED. CONNECT THE TWO CYLINDERS WITH A PIECE OF HOSE AND FILL THE CYLINDERS WITH OIL TO AN EQUAL LEVEL. PLACE A ONE POUND WEIGHT ON ONE CYLINDER. THE CYLINDER WITH NO WEIGHT IS RAISED AN EQUAL AMOUNT. THE PRESSURE CREATED BY THE ONE POUND WEIGHT IS APPLIED THROUGHOUT BOTH CYLINDERS. THIS EXAMPLE ILLUSTRATES THE THIRD PRINCIPLE OF HYDRAULICS: (3) LIQUIDS TRANSMIT APPLIED PRESSURE EQUALLY IN ALL DIRECTIONS.

TWO HYDRAULIC CYLINDERS ARE NEEDED TO ILLUSTRATE THE FOURTH PRINCIPLE OF HYDRAULICS -- ONE CYLINDER WITH A PISTON AREA OF ONE SQUARE INCH AND ANOTHER CYLINDER WITH A PISTON AREA OF FIVE SQUARE INCHES. CONNECT THE CYLINDERS WITH A TUBE. APPLY A ONE POUND WEIGHT TO THE SMALLER CYLINDER AND A FIVE POUND WEIGHT TO THE LARGER CYLINDER. THE CYLINDER PISTONS WILL BE MAINTAINED AT EQUAL LEVELS EVEN THOUGH THE WEIGHT ON THE LARGER CYLINDER IS FIVE TIMES GREATER THAN ON THE SMALLER ONE. THE PRESSURE OF ONE POUND PER SQUARE INCH APPLIED TO THE SMALLER CYLINDER IS APPLIED TO THE LARGER CYLINDER WHICH HAS A PISTON AREA OF FIVE SQUARE INCHES INCREASING THE TOTAL WORK FORCE OF THE LARGER PISTON FIVE TIMES (OR FIVE POUNDS). THEREFORE, THE FOURTH PRINCIPLE OF HYDRAULICS IS: (4) LIQUIDS PROVIDE A GREAT INCREASE IN WORK FORCE.

MOST BASIC HYDRAULIC CIRCUITS ARE ESSENTIALLY THE SAME REGARDLESS OF THE APPLICATION. THE FOUR COMPONENTS OF A BASIC HYDRAULIC SYSTEM ARE: (1) A RESERVOIR TO STORE FLUID; (2) A HYDRAULIC PUMP TO CREATE OIL FLOW THROUGHOUT THE SYSTEM; (3) VARIOUS CONTROL VALVES TO REGULATE FLUID DIRECTION, VOLUME OF OIL FLOW, AND SYSTEM PRESSURE; AND (4) AN ACTUATOR OR CYLINDER TO CONVERT THE FLUID ENERGY INTO MECHANICAL ENERGY. A HYDRAULIC SYSTEM IS SO FLEXIBLE THAT IT CAN BE ADAPTED TO PRODUCE UNLIMITED VARIATIONS OF MOTION AND FORCE.

---

[1] ATLAND, GEORGE. PRACTICAL HYDRAULICS. TROY, MICHIGAN: VICKERS INCORPORATED, DIVISION OF SPEERY RAND CORPORATION, N.D.

HYDRAULIC CONTROL VALVES[2]

HYDRAULIC CONTROL VALVES DICTATE THE DIRECTION OF FLUID FLOW, THE VOLUME OF FLUID FLOW, AND THE AMOUNT OF SYSTEM PRESSURE.

PRESSURE CONTROL VALVES

THERE ARE THREE TYPES OF PRESSURE CONTROL VALVES. THEY ARE USED TO (1) LIMIT SYSTEM PRESSURE, (2) REDUCE SYSTEM PRESSURE, (3) UNLOAD THE HYDRAULIC PUMP, AND (4) ESTABLISH THE PRESSURE AT WHICH OIL ENTERS A CIRCUIT. THE FOLLOWING IS A BRIEF DESCRIPTION OF VARIOUS PRESSURE CONTROL VALVES.

RELIEF VALVES ARE THE MOST COMMON TYPE OF PRESSURE CONTROL VALVE USED TO PROVIDE PROTECTION AGAINST OVERLOADING THE HYDRAULIC CIRCUIT OR ITS COMPONENTS. RELIEF VALVES ARE REQUIRED IN PRACTICALLY ALL HYDRAULIC CIRCUITS EXCEPT WHERE THE COMPENSATOR OF A VARIABLE DELIVERY PUMP IS CAPABLE OF PROVIDING THE NECESSARY OVERLOAD PROTECTION TO THE SYSTEM. THE RELIEF VALVE IS INSTALLED IN A HYDRAULIC CIRCUIT WITH ONE PART CONNECTED TO THE HIGH PRESSURE SIDE OF THE CIRCUIT AND THE OTHER PART CONNECTED TO THE LOW PRESSURE SIDE OF THE CIRCUIT OR THE RESERVOIR RETURN LINE. THE RELIEF VALVE IS HELD ON THE VALVE SEAT BY SPRING TENSION. SOME RELIEF VALVES ARE PRESET AT THE FACTORY AND CANNOT BE ADJUSTED. ADJUSTABLE RELIEF VALVES MAY BE REGULATED BY TURNING THE ADJUSTING SCREW IN TO INCREASE SPRING TENSION OR OUT TO REDUCE SPRING TENSION. OTHERS MAY BE ADJUSTED BY ADDING SHIMS TO REDUCE SPRING TENSION OR REMOVING SHIMS TO INCREASE SPRING TENSION.

A PRESSURE REDUCING VALVE IF USED TO LIMIT THE PRESSURE IN A SECONDARY CIRCUIT BELOW THAT IN THE MAIN HYDRAULIC CIRCUIT. WHEN A PRESSURE REDUCING VALVE IS NOT OPERATING, THE VALVE IS OPEN. WHEN IT IS IN OPERATION THE VALVE TENDS TO CLOSE CAUSING A RESTRICTION WHICH RESULTS IN A PRESSURE DROP ON THE OTHER SIDE OF THE VALVE. THE VALVE BEGINS TO OPERATE WHEN THE PRESSURE IN THE SECONDARY CIRCUIT RISES EXERTING FORCE ON THE BOTTOM OF THE VALVE SPOOL PARTIALLY CLOSING THE VALVE. SPRING TENSION PROVIDES THE RESISTANCE TO THE OIL PRESSURE SO THAT ONLY THE AMOUNT OF OIL THAT PASSES THE VALVE IS NEEDED TO SERVE THE SECONDARY CIRCUIT AT THE DESIRED PRESSURE. THE SPRING TENSION ON A PRESSURE REDUCING VALVE MAY BE CHANGED BY TURNING THE ADJUSTING SCREW. THIS VALVE OPERATES IN THE REVERSE OF A RELIEF VALVE. THE RELIEF VALVE SENSES PRESSURE FROM THE INLET SIDE OR HIGH PRESSURE SIDE OF THE CIRCUIT AND IS CLOSED WHEN NOT IN OPERATION. THE PRESSURE SENSING OF THE REDUCING VALVE IS FROM THE VALVE'S OUTLET SIDE OR SECONDARY CIRCUIT. THE PRESSURE REDUCING VALVE LIMITS MAXIMUM PRESSURE IN THE SECONDARY CIRCUIT, REGARDLESS OF THE DIFFERENT PRESSURE CHANGES IN THE MAIN CIRCUIT. HOWEVER, IF THE SYSTEM'S WORK LOAD

---

[2] FUNDAMENTALS OF SERVICE - HYDRAULICS. MOLINE, ILLINOIS: DEERE AND COMPANY. SECOND EDITION, 1972.

SHOULD CREATE BACKFLOW INTO THE REDUCING VALVE PART, THE BACKFLOW WILL CLOSE THE VALVE COMPLETELY.

PRESSURE SEQUENCE VALVES ARE USED TO CONTROL THE PRIORITY OF FLOW TO DIFFERENT BRANCHES OF A CIRCUIT. GENERALLY, THE VALVE ONLY ALLOWS FLOW TO A SECOND CIRCUIT AFTER THE FIRST CIRCUIT HAS BEEN FULLY SATISFIE WHEN THE VALVE IS CLOSED OR THERE IS NO DEMAND IN THE SECONDARY CIRCUIT, THE VALVE DIRECTS THE OIL FREELY TO THE PRIMARY CIRCUIT. THE VALVE OPENS WHEN THE PRESSURE IN THE PRIMARY CIRCUIT REACHES A PRESET POINT (ADJUSTABLE BY TURNING SCREW IN OR OUT ON VALVE SPRING). THE VALVE IS LIFTED OFF ITS SEAT AND OIL BEGINS TO FLOW THROUGH THE LOWER VALVE PORT TO THE SECONDARY CIRCUIT. A COMMON USE OF THE SEQUENCE VALVE IS TO REGULATE THE OPERATING SEQUENCE OF TWO INDIVIDUAL CYLINDERS. THE SECOND CYLINDER DOES NOT BEGIN ITS STROKE UNTIL THE FIRST CYLINDER COMPLETES ITS STROKE. IN THIS SITUATION, THE SEQUENCE VALVE MAINTAINS PRESSURE ON THE FIRST CYLINDER DURING THE OPERATION OF THE SECOND CYLINDER.

DIRECTIONAL CONTROL VALVES

USE OF DIRECTIONAL CONTROL VALVES DIRECTS THE FLOW OF FLUID IN THE HYDRAULIC SYSTEM. THERE ARE THREE TYPES OF DIRECTIONAL CONTROL VALVES. EACH USES A DIFFERENT TYPE OF VALVING ACTION TO DIRECT OIL FLOW.

CHECK VALVES ARE SIMPLE ONE-WAY VALVES. THEY OPEN TO ALLOW FLOW IN ONLY ONE DIRECTION AND CLOSE TO PREVENT FLOW IN THE OPPOSITE DIRECTION. THE CHECK VALVE USES A POPPET WHICH SEATS AND UNSEATS TO CONTROL THE FLO OF OIL. THE VALVE IS OPENED BY SYSTEM PRESSURE WHICH PUSHES THE VALVE OFF ITS SEAT UP AGAINST THE SPRING. OIL THEN FLOWS FREELY PAST THE VALV THE VALVE CLOSES DUE TO SPRING TENSION WHERE THE SYSTEM'S PRESSURE DROPS THIS ACTION PREVENTS THE REVERSE FLOW OF OIL THROUGH THE VALVE AND TRAPS THE EXISTING PRESSURIZED OIL IN THE CIRCUIT.

ROTARY DIRECTIONAL VALVES ARE COMMONLY USED AS PILOT VALVES TO DIRECT OIL FLOW TO OTHER VALVES. THE VALVE HEAD HAS DRILLED HOLES WHICH MATCH HOLES IN THE MAIN VALVE BODY. THE VALVE HEAD IS ROTATED MANUALLY, HYDRAULICALLY, OR ELECTRICALLY TO ALIGN THE OIL PASSAGES AND ALLOW PRESSURIZED OIL TO ENTER THE VALVE PORT, FLOW THROUGH THE VALVE AND OUT ANOTHER PORT TO THE WORK. OIL IS ALSO BEING RETURNED FROM ANOTHER WORK PORT THROUGH THE VALVE TO THE RESERVOIR. USUALLY, ROTARY VALVES ARE USE IN LOW PRESSURE AND LOW VOLUME SITUATIONS. THE DRILLED PORTS IN THE VAL ARE ON TWO DIFFERENT LEVELS TO SEPARATE THEM.

THE SLIDING SPOOL DIRECTIONAL VALVE IS CONSIDERED THE TRUE DIRECTIO CONTROL VALVE. IT USES OIL TO START, OPERATE, AND STOP THE ACTUATING UNITS ON THE MAJORITY OF MODERN HYDRAULIC SYSTEMS. THE VERSATILITY OF T SPOOL VALVE DESIGN IS UNLIMITED. THE MOST COMMON SPOOL VALVES ARE TWO, FOUR, AND SIX LAND SPOOLS. HOWEVER, THE SPOOL VALVE IS OFTEN USED IN VALVE STACKS OF TWO OR MORE. WHEN USED IN A VALVE STACK EACH SPOOL WILL CONTROL ONE BRANCH OF THE TOTAL CIRCUIT. THE SPOOL IS HARDENED AND GROU TO PRODUCE A SMOOTH, ACCURATE AND DURABLE SURFACE.

THERE ARE TWO TYPES OF THE SPOOL VALVES WHICH DRAMATICALLY EFFECT THE HYDRAULIC SYSTEM: (1) AN OPEN CENTER SPOOL VALVE ALLOWS PUMPED OIL TO FLOW THROUGH THE VALVE WHEN IN THE NEUTRAL POSITION, AND INTO THE RESERVOIR. A HYDRAULIC SYSTEM USING THE OPEN CENTER SPOOL VALVE HAS A CONTINUOUSLY RUNNING HYDRAULIC PUMP. (2) A CLOSED CENTER SPOOL VALVE STOPS THE FLOW OF OIL FROM THE PUMP WHEN IN NEUTRAL. THIS TRAPS OIL BETWEEN THE PUMP AND THE CONTROL VALVE AND MAINTAINS PRESSURIZED OIL FOR A QUICK RESPONSE UPON DEMAND. A CLOSED CENTER SYSTEM REQUIRES PUMP OPERATION ONLY ON DEMAND.

SPOOL VALVES ARE POPULAR ON HYDRAULIC SYSTEMS FOR THE FOLLOWING REASONS:

QUICK, POSITIVE ACTION - THEY ARE PRECISION GROUND FOR FINE OIL METERING.
ADAPTABILITY - ADDITIONAL LANDS AND PORTS ALLOW SPOOL VALVES TO HANDLE OIL FLOW IN MANY DIRECTIONS.
COMPACTNESS - STACKING OF SPOOL VALVES IN ONE COMPACT CONTROL PACKAGE IS IMPORTANT ON MOBILE SYSTEMS.

SPOOL VALVES REQUIRE GOOD MAINTENANCE. DIRTY OIL WILL DAMAGE THE VALVE MATING SURFACES AND THE VALVE WILL LOSE ACCURACY. DIRT WILL ALSO CAUSE VALVE STICKING AND ERRATIC WORK ACTION.

VOLUME CONTROL VALVES

VOLUME CONTROL VALVES REGULATE THE AMOUNT OF OIL FLOW BY RESTRICTING OR DIVERTING THE OIL. THEY ARE USED IN HYDRAULIC SYSTEMS WHEN THE SPEED OF A CYLINDER OR MOTOR MUST BE CLOSELY REGULATED. VOLUME CONTROL VALVES CAN BE SEPARATED INTO TWO TYPES.

FLOW CONTROL VALVES USUALLY REGULATE THE OIL FLOW THROUGH A METERING DEVICE. THE METERING SYSTEM MAY RESTRICT FLOW IN OR OUT OF THE COMPONENT WHOSE SPEED IS BEING REGULATED. THE METERING DEVICE MAY ALSO DIVERT FLOW AWAY FROM THE COMPONENT WHOSE SPEED IS BEING REGULATED

FLOW DIVIDER VALVES CONTROL VOLUME BY DIVIDING THE FLOW OF OIL BETWEEN TWO OR MORE CIRCUITS. FLOW DIVIDER VALVES MAY ACCOMPLISH THIS TASK IN THREE WAYS: (1) PRIORITY FLOW DIVIDER VALVES DELIVER ALL THE FLUID TO ONE CIRCUIT UNTIL THE FLOW EXCEEDS THE NEEDS OF THAT CIRCUIT, THEN DIVERTS THE EXCESS OIL TO OTHER CIRCUITS. (2) ADJUSTABLE PRIORITY FLOW DIVIDER VALVES DELIVER ALL THE FLUID TO ONE CIRCUIT UNTIL ITS DEMANDS ARE MET, THEN DIVERT THE REMAINING OIL TO OTHER CIRCUITS. THE ADJUSTABLE PRIORITY DIFFERS FROM THE PRIORITY IN THAT THE PRIORITY CIRCUIT CANNOT BE CHANGED. (3) PROPORTIONAL FLOW DIVIDER VALVES DELIVER OIL TO ALL THE CIRCUITS AT THE SAME TIME. BUT, THE DELIVERY TO EACH CIRCUIT CAN BE CHANGED. THE RATIO BETWEEN TWO CIRCUITS CAN BE A RATIO ANYWHERE FROM 50-50 TO 90-10.

CYLINDERS[3]

THE NEXT FACTOR UNDER CONSIDERATION IS TO EXAMINE HOW THE WORK IS DONE. THE CYLINDER CONVERTS THE FLUID POWER FROM THE PUMP BACK INTO MECHANICAL POWER. MANY TIMES THE CYLINDERS ARE CALLED THE "ARMS" OF THE HYDRAULIC CIRCUIT. THERE ARE TWO MAJOR TYPES OF HYDRAULIC CYLINDERS TO BE DISCUSSED IN THIS UNIT: SINGLE-ACTING CYLINDERS AND DOUBLE-ACTING CYLINDERS.

SINGLE-ACTING CYLINDERS WILL PRODUCE FORCE IN ONLY ONE DIRECTION. PRESSURIZED OIL IS ADMITTED TO ONLY ONE SIDE OF THE PISTON. THE PISTON AND ROD ARE FORCED OUT OF THE HOUSING MOVING THE LOAD. WHEN THE OIL PRESSURE IS RELEASED, THE WEIGHT OF THE LOAD (GRAVITY) OR A SPRING DEVICE FORCES THE ROD BACK INTO THE HOUSING. THE OTHER SIDE OF THE CYLINDER IS DRY. A SMALL AIR VENT IS REQUIRED TO RELEASE AIR WHEN THE PISTON ROD EXTENDS AND TO ALLOW AIR IN WHEN THE ROD RETRACTS. THE AIR VENT HELPS THE CYLINDER TO WORK SMOOTHLY AND PREVENTS A VACUUM FROM DEVELOPING. THE AIR VENT USUALLY HAS A POROUS BREATHER TO KEEP DIRT OUT OF THE CYLINDER. INSIDE THE CYLINDER, A SEAL ON THE PISTON PROHIBITS OIL LEAKAGE PAST THE PISTON INTO THE DRY SIDE OF THE CYLINDER. ON THE ROD END OF THE CYLINDER A WIPER SEAL IS USED TO CLEAN THE ROD AS IT MOVES IN AND OUT OF THE CYLINDER HOUSING.

HOWEVER, SOME SINGLE-ACTING CYLINDERS DO NOT HAVE A PISTON ON THE INNER END. INSTEAD, THE END OF THE ROD SERVES AS THE PISTON. THIS IS KNOWN AS A RAM-TYPE CYLINDER. THE ROD IS ONLY SLIGHTLY SMALLER THEN THE INSIDE DIAMETER OF THE CYLINDER. THE RAM HAS A SMALL SHOULDER OR RING ON THE END OF THE ROD TO KEEP THE ROD FROM BEING PUSHED OUT OF THE CYLINDER.

THE RAM-TYPE CONSTRUCTION HAS SOME ADVANTAGES OVER THE PISTON-TYPE CYLINDER: (1) THE ROD IS LARGER AND RESISTS BENDING CAUSED BY SIDE LOADS; (2) THE PACKING IS ON THE OUTSIDE AND EASIER TO REACH FOR REPAIRS; (3) SCORING INSIDE THE CYLINDER BORE WILL NOT DAMAGE THE PACKINGS; AND (4) NO AIR VENT IS NEEDED SINCE OIL OR THE ROD OCCUPIES THE WHOLE INNER CHAMBER OF THE CYLINDER HOUSING ALL THE TIME.

DOUBLE-ACTING CYLINDERS PROVIDE FORCE IN EITHER DIRECTION. PRESSURIZED OIL ENTERS ONE END TO EXTEND IT AND THE OTHER END TO RETRACT IT. THE OIL FROM THE OPPOSITE END OF THE CYLINDER IS RETURNED TO THE RESERVOI EACH TIME. IN THE DOUBLE-ACTING CYLINDER, BOTH THE PISTON HEAD AND THE ROD MUST BE SEALED TO PREVENT OIL LEAKAGE.

THERE ARE TWO TYPES OF DOUBLE-ACTING CYLINDERS: UNBALANCED AND BALANCED. UNBALANCED DOUBLE-ACTING CYLINDERS HAVE A TOTAL FORCE ON THE ROD SIDE OF THE PISTON LESS THAN THAT ON THE BLANK SIDE OF THE PISTON. THE DIFFERENCE IN THE TOTAL FORCE IS EXPLAINED BY THE DIFFERENCE IN PISTON AREA EXPOSED TO THE OIL PRESSURE. THIS TYPE OF CYLINDER IS USUALLY USED WHEN A SLOWER, MORE POWERFUL STROKE IS DESIRED FOR EXTENSION, AND WHEN A FASTER, LESS POWERFUL STROKE IS NEEDED FOR RETRACTION.

---

[3] IBID.

BALANCED DOUBLE-ACTING CYLINDERS HAVE THE PISTON ROD EXTENDING THROUGH THE PISTON HEAD ON BOTH SIDES. THE FACT THAT THE PISTON ROD EXTENDS ON BOTH SIDES OF THE PISTON HEAD CREATES AN EQUAL WORKING AREA ON BOTH SIDES OF THE PISTON, THEREFORE BALANCING THE WORKING FORCE OF THE CYLINDER WHETHER IT IS EXTENDING OR RETRACTING.

IT SHOULD BE NOTED THAT THE EXPLANATION OF THE BALANCE AND UNBALANCE OF THESE CYLINDERS ASSUMES THAT AN EQUAL LOAD IS BEING APPLIED TO BOTH SIDES OF THE CYLINDERS. IF THE LOADS ARE UNEQUAL IN EACH DIRECTION, THE BALANCE WILL VARY.

HYDRAULIC FILTERING SYSTEMS[4&5]

HYDRAULIC FLUIDS ARE THE LUBRICANTS FOR THE PRECISION PARTS OF THE SYSTEM. THEREFORE, IT MIGHT BE WELL TO CONSIDER THE FILTERING SYSTEM. CONTAMINATED OIL CAN SCORE OR FREEZE PRECISELY FITTED HYDRAULIC PARTS. DIRTY OIL CAN RUIN THE TOLERANCES OF FINELY FITTED PARTS, AND PLUG A SMALL OIL CONTROL ORIFICE TO PUT A MACHINE OUT OF OPERATION. IT IS EASY TO SEE THAT THE OIL MUST BE KEPT CLEAN IF THE HYDRAULIC SYSTEM IS TO OPERATE WITHOUT TROUBLE. DIRT IS EVERYWHERE AND THE AIR SURROUNDING A MACHINE IS A MAJOR SOURCE OF CONTAMINATION. THE MACHINE ITSELF IS A SOURCE OF CONTAMINATION, AS WEAR PRODUCES CHIPS AND BURRS OF METAL. THEREFORE, A GOOD FILTER AND FILTER SYSTEM IS NEEDED TO MAINTAIN THE SYSTEM PROPERLY.

THERE ARE TWO MAJOR TYPES OF FILTER SYSTEMS:

A FULL-FLOW FILTER SYSTEM PASSES THE ENTIRE OIL SUPPLY THROUGH THE FILTER EACH TIME IT CIRCULATES THE HYDRAULIC SYSTEM. FILTERS IN A FULL-FLOW SYSTEM ARE USUALLY LOCATED IN THE PUMP INLET LINE. OF COURSE, ADDITIONAL FILTERS MAY BE LOCATED IN FRONT OR BEHIND OTHER HYDRAULIC COMPONENTS IF THEY ARE NEEDED.

THE BY-PASS FILTER SYSTEM IS CONNECTED TO A TEE IN THE PRESSURE LINE SO THAT ONLY A SMALL PORTION OF EACH OIL CYCLE IS DIVERTED THROUGH THE FILTER. THE REMAINDER OF THE OIL PASSES THROUGH THE SYSTEM UNFILTERED.

THE LOCATION OF THE FILTER WILL VARY WITH THE MACHINE DESIGN. THE ONE PURPOSE OF THE FILTER SYSTEM IS TO KEEP THE OIL CLEAN. AS OIL IS PUMPED THROUGH THE FILTER AND THE OIL OUTSIDE THE FILTER BECAUSE THE OIL IS BEING RESTRICTED AS IT PASSES THROUGH THE FILTER. IN TIME, AS

---

[4] HYDRAULIC FUNDAMENTALS AND INDUSTRIAL HYDRAULIC OILS. COLUMBUS, OHIO: SUN OIL TECHNICAL BULLETIN B-4, 1963.

[5] FUNDAMENTALS OF SERVICE - HYDRAULICS. OPCIT.

THE FILTER GETS DIRTY AND THE PRESSURE DIFFERENCES INCREASE, THE FILTER MAY BECOME COMPLETELY CLOGGED AND NO OIL WILL FLOW. THIS WOULD RESULT IN A PRESSURE BUILD-UP. TO PREVENT THE PRESSURE FROM RUPTURING THE FILTER OR STARVING THE HYDRAULIC SYSTEM, A RELIEF VALVE IS PLACED IN THE FILTER TO ALLOW OIL TO BY-PASS THE FILTER. THIS IS NOT THE SAME AS A BY-PASS FILTER SYSTEM. THE RELIEF VALVE OPERATES ONLY WHEN THE FILTER IS PLUGGED. OF COURSE, WHEN THE RELIEF VALVE OPENS, DIRTY OIL POURS INTO THE HYDRAULIC SYSTEM. IF THE FILTER IS NOT SERVICED IMMEDIATELY, THE DIRTY OIL WILL INCREASE WEAR IN THE HYDRAULIC SYSTEM AND EVENTUALLY THE INLET SCREEN WILL PLUG AND CAUSE PUMP STARVATION. CARE MUST BE TAKEN TO SEE THAT THE CORRECT FILTER AND HYDRAULIC OIL ARE USED IN A SYSTEM WITH A RELIEF VALVE IN THE FILTER. USE OF THE WRONG FILTER OR HYDRAULIC OIL MAY DEVELOP A PRESSURE DIFFERENCE INSIDE AND OUTSIDE THE FILTER THAT EXCEEDS THE RELIEF VALVE SETTING, AND THE VALVE WILL OPEN AND RELEASE UNFILTERED OIL.

FILTER ELEMENTS

FILTER ELEMENTS CAN BE CLASSIFIED AS EITHER SURFACE-TYPE OR DEPTH-TYPE DEPENDING ON THE WAY THEY REMOVE DIRT FROM THE HYDRAULIC OIL.

SURFACE FILTERS USE THE OUTSIDE SURFACE OF THE FILTER TO CATCH AND REMOVE DIRT PARTICLES THAT ARE LARGER THAN THE FILTER PERFORATIONS. THE FILTER STRAINS THE DIRT FROM THE OIL IT PASSES THROUGH THE FILTER PERFORATIONS. THE LARGE PARTICLES OF DIRT WILL FALL TO THE BOTTOM OF THE FILTER CONTAINER, BUT OVERTIME DIRT PARTICLES WILL PLUG THE HOLES OF THE FILTER TO PREVENT FILTRATION. SURFACE FILTERS ARE MADE OF THE FOLLOWING MATERIALS: FINE WIRE MESH, STACKED METAL, PAPER DISK, METAL RIBBON WOUND EDGEWISE, CELLULOSE MATERIAL MOLDED INTO A FILTER, AND ACCORDIAN-PLEATED PAPER.

DEPTH FILTERS USE A LARGE VOLUME OF MATERIAL WHICH FORCES THE OIL TO MOVE THROUGH THE FILTER IN MANY DIFFERENT DIRECTIONS. ABSORBENT DEPTH FILTERS RESEMBLE A SPONGE SOAKING UP WATER. THE HYDRAULIC OIL PASSES THROUGH THE POROUS MATERIAL OF THE FILTER (E.G., COTTON WASTE, WOOD PULP, WOOL YARN, PAPER OR QUARTZ) TRAPPING THE DIRT IN THE FILTER. AN ABSORBENT FILTER WILL REMOVE DIRT AND SOME WATER SUSPENDED IN THE OIL.

ADSORBENT FILTERS OPERATE LIKE THE ABSORBENT FILTERS EXCEPT THEY ARE TREATED CHEMICALLY TO ATTRACT AND REMOVE OIL CONTAMINANTS. THESE FILTERS ARE USUALLY MADE OF CHARCOAL, CHEMICALLY-TREATED PAPER, OR FULLER'S EARTH. ADSORBENT FILTERS WILL NOT ONLY REMOVE OIL CONTAMINANTS BUT MAY ALSO REMOVE DESIRABLE ADDITIVES FROM THE OIL. THIS TYPE OF FILTER IS NOT USUALLY USED IN HYDRAULIC SYSTEMS FOR THIS REASON.

HYDRAULIC FLUID PROPERTIES[6]

THE SIGNIFICANT PROPERTIES OF HYDRAULIC FLUIDS ARE CONSIDERED IMPORTANT CHARACTERISTICS TO USE IN SELECTING OILS. HOWEVER, CHOOSING A HYDRAULIC OIL IS NOT AN EXACT SCIENCE. THERE ARE NO SET OIL SPECIFICATIONS TO PROVIDE ALL THE INFORMATION ONE NEEDS. GENERALLY, TWO SOURCES OF INFORMATION ARE AVAILABLE, THE MANUFACTURER OF THE EQUIPMENT AND THE OIL SUPPLIER OR MANUFACTURER.

YARDSTICKS FOR MEASURING THE SUITABILITY OF ANY GIVEN OIL FOR A HYDRAULIC SYSTEM ARE STANDARD SPECIFICATIONS AND PERFORMANCE DATA. THE SPECIFICATIONS MAY BE USED TO SELECT THE OIL WITH THE CORRECT VISCOSITY INDEX AND OTHER OIL CHARACTERISTICS THAT CAN BE EASILY CHECKED IN THE LABORATORY AND THAT HAVE A RELATION TO SATISFACTORY OIL PERFORMANCE. PERFORMANCE DATA SETS THE GUIDELINES IN SELECTING AN OIL THAT WILL PROVIDE EFFICIENT POWER TRANSMISSION AND ADEQUATE LUBRICATION.

IN ORDER TO SELECT THE RIGHT HYDRAULIC OIL FOR A HYDRAULIC SYSTEM, ONE SHOULD BE AWARE OF THE FOLLOWING FLUID PROPERTIES:

VISCOSITY IS GENERALLY CONSIDERED TO BE THE MOST IMPORTANT CHARACTERISTIC OF A HYDRAULIC OIL. IF A HYDRAULIC OIL HAS AN INCORRECT VISCOSITY FOR THE HYDRAULIC SYSTEM IT WILL NOT PERFORM SATISFACTORILY, REGARDLESS OF HOW SUPERIOR THE OIL MAY BE IN OTHER RESPECTS. VISCOSITY ALSO HAS A DIRECT BEARING ON THE EFFICIENT TRANSMISSION OF POWER. IN ORDER FOR A HYDRAULIC TO PERFORM SATISFACTORILY, THE OIL MUST FLOW READILY THROUGH ALL COMPONENTS OF THE SYSTEM. IF THE OIL IS TOO LIGHT, LEAKAGE BECOMES A PROBLEM. THE HIGHER THE RATE OF LEAKAGE, THE LOWER THE EFFICIENCY OF THE OIL. ALSO, VISCOSITY HAS A DIRECT EFFECT ON ADEQUATE LUBRICATION AS THE FLUID IS THE ONLY SOURCE OF LUBRICATION IN THE SYSTEM.

THE SELECTION OF AN OIL THAT IS TOO LIGHT MAY RESULT IN:

- EXCESSIVE LEAKAGE.
- LOWER VOLUMETRIC EFFICIENCY OF THE PUMP.
- INCREASED WEAR.
- LOSS OF PRESSURE.
- LACK OF POSITIVE HYDRAULIC CONTROL.
- LOWER OVERALL EFFICIENCY.

---

[6] CONDENSED FROM ATLAND, GEORGE. PRACTICAL HYDRAULICS. TROY, MICHIGAN: VICKERS INCORPORATED, DIVISION OF SPERRY RAND CORPORATION, N.D.

SELECTING AN OIL TOO HEAVY MAY RESULT IN:

- INCREASED PRESSURE DROP.
- HIGHER OIL TEMPERATURES.
- SLUGGISH OPERATION.
- LOWER MECHANICAL EFFICIENCY.
- HIGHER POWER CONSUMPTION.

TO RECEIVE OPTIMUM EFFICIENCY FROM THE HYDRAULIC SYSTEM, THE OIL SELECTED MUST HAVE THE CORRECT VISCOSITY AT OPTIMUM OPERAING TEMPERATURE. THE VISCOSITY RECOMMENDATION FOR SPECIFIC EQUIPMENT IS AVAILABLE FROM THE EQUIPMENT MANUFACTURER.

THE VISCOSITY INDEX (VI) IS THE UNIT MEASURE OF THE CHANGE IN VISCOSITY WITH THE CHANGE IN OPERATING TEMPERATURE. THE HIGHER THE VI, THE SMALLER THE CHANGE IN THE VISCOSITY WITH A GIVEN CHANGE IN OPERATING TEMPERATURE.

THE MANUFACTURERS OF HYDRAULIC EQUIPMENT PROVIDE TWO IMPORTANT GUIDES FOR SELECTING THE HYDRAULIC OIL WITH THE CORRECT VISCOSITY FOR THE OPERATING TEMPERATURE. THE TWO GUIDES ARE (1) MINIMUM VI; AND (2) VISCOSITY AT 100°F, THE STANDARD TEST TEMPERATURE.

OIL OXIDATION TAKES PLACE IN ALL HYDRAULIC SYSTEMS AND MUST BE CONTROLLED. THE OXIDATION RATE INCREASES IN DIRECT PROPORTION TO THE TEMPERATURE AND PERCENTAGE OF CONTAMINANTS.

RESINS AND OTHER OXIDATION PRODUCTS BEGIN TO FORM IMMEDIATELY AFTER AN OIL IS PUT IN USE; THE RATE OF FORMATION CAN BE EXTREMELY LOW OR EXCEEDINGLY HIGH, DEPENDING ON THE OIL AND OPERATING CONDITIONS. WHEN THESE PRODUCTS COME INTO CONTACT WITH HOT SURFACES, THERE IS A TENDENCY FOR SOME PRODUCTS TO BE CHANGED INTO INSOLUBLE COMPOUNDS THAT MAY EITHER BAKE OUT ON THE HOT SURFACES OR CIRCULATE AS SOLIDS SUSPENDED IN THE OIL. THE COMPOUNDS THAT BAKE OUT ARE CALLED VARNISHES OR LACQUERS; OTHER FORMS OFTEN SETTLE OUT AT SOME LOW POINT IN A HYDRAULIC SYSTEM AND ARE CALLED SLUDGES.

OBVIOUSLY A HIGH RATE OF OXIDATION CANNOT BE TOLERATED IN A HYDRAULIC SYSTEM BECAUSE THE PRODUCTS OF OXIDATION CLOG SMALL ORIFICES AND TEND TO JAM TIGHT-FITTED PARTS AND DESTROY THE BALANCE OF THE SYSTEM. ALSO, PRODUCTS OF OXIDATION ARE ACIDIC; THEY ARE LIKELY TO ATTACK METAL PARTS AND DESTROY THE MACHINED SURFACES. RATES OF OXIDATION INCREASE WITH: (1) INCREASE IN TEMPERATURE AND (2) INCREASE IN CONTAMINATION.

ANOTHER PROPERTY OF HYDRAULIC FLUID IS THE POUR POINT, WHICH MEASURES THE RELATIVE ABILITY OF THE OIL TO FLOW AT LOW TEMPERATURES. THE POUR POINT OF OIL IS OF IMPORTANCE ONLY WHEN EQUIPMENT MUST BE STARTED AT LOW TEMPERATURES. FOR MOST HYDRAULIC INSTALLATIONS, THE POUR POINT SHOULD BE AT LEAST 20-30°F BELOW THE LOWEST OPERATING TEMPERATURE OF THE EQUIPMENT.

Other properties of fluids usually discussed are wear prevention, rust and corrosion prevention, resistance to foaming, and the ability to separate from water. However, there are no specific tests that provide accurate data on these properties.

Oil contamination is the major factor in determining the life of the hydraulic system. Liquids, metallic particles and non-mettalic particles and fibers are materials that can contaminate the oil. These contaminants may be introduced into the oil from both inside and outside the system. The air surrounding the unit is a major source of contamination. The air contains moisture and dust particles. These contaminants may enter the system through breathers, post seals and gaskets or when the system is open for repair or maintenance. Hydraulic oil is contaminated during maintenance when unclean containers, funnels, dirty oil, or dirty and linty wiping cloths are used.

The hydraulic machine is another good source of contamination. During operation bits of metal and other abrasives such as, paint and pieces of seals, and gaskets caused by wear, are introduced in the fluid.

Also, the oil itself is a source of contamination. As oil works in the system, sludge and acids form due to chemical reaction to water, air, heat, and pressure. Sludge is a gummy substance that will coat moving parts, clog small openings, and trap abrasive particles suspended in the oil. Acids will corrode and pit machined surfaces causing wear and additional contamination to the oil.

All of these contaminants may have a serious effect on the operating efficiency of the hydraulic system. Water causes rusting of metal surfaces and helps create sludge. Sludge may plug the filter causing increased circulation of dirty oil, or it may even starve the hydraulic components. Acids may form with sludge and corrode parts which will add more particles to the oil. Metallic and non-metallic particles circulating in the oil will cause apparent damage. Large particles will catch on the edges of moving parts and either increase sludge buildup, or wear on the metering edges of valves. Smaller particles will become trapped between closely fitted parts causing them to stick or freeze. Other particles will embed themselves in soft metals to scope moving parts and seals, which will cause internal leakage and loss of machine efficiency. The lint fibers from wiping cloths may mat together to clog small orifices. The fibers themselves do little harm but they provide a collection area for solid particles that will plug and wear hydraulic components. It is important to remember that each abrasive particle will produce additional contamination to damage the machine.

Diagnosis and Testing of Hydraulic Systems

Today's complex hydraulic systems dictate the need of a good program of diagnosis and testing. Such a program would include seven

BASIC STEPS:[7]

1. KNOW THE SYSTEM. STUDY THE MACHINE'S TECHNICAL MANUALS. KNOW HOW THE SYSTEM WORKS, WHETHER IT IS OPEN OR CLOSED-CENTER, THE CORRECT VALVE PRESSURE SETTINGS, AND THE PUMP OUTPUT.

2. ASK THE OPERATOR. FIND OUT FROM THE OPERATOR HOW THE MACHINE ACTED WHEN IT STARTED TO FAIL. FIND OUT IF ANY SERVICE HAS BEEN PERFORMED.

3. OPERATE THE MACHINE. GET ON THE MACHINE AND OPERATE IT. WARM IT UP AND PUT IT THROUGH ITS PACES. DO THE GAUGES READ NORMAL? IS THE PERFORMANCE SLOW, ERRACTIC OR NIL? ARE THE CONTROLS SOLID, STICKY OR SPONGY? DOES ANYTHING SMELL DIFFERENT? ARE THERE SIGNS OF SMOKE? DO YOU HEAR ANY STRANGE SOUNDS -- WHERE -- AT WHAT SPEEDS OR DURING WHAT CYCLES?

4. INSPECT THE MACHINE. DISMOUNT THE MACHINE AND MAKE A VISUAL CHECK FOR SIGNS OF TROUBLE. CHECK THE OIL AND OIL LEVEL. CHECK THE FILTERS FOR CLOGGING. CHECK FOR LINE RESTRICTIONS AND COLLASPED HOSES. LOOK FOR OIL AND AIR LEAKS AT LINE CONNECTORS AND HOSE CLAMPS. LOOK CLOSELY AT THE COMPONENTS AND INSPECT FOR CRACKS, LOOSE BOLTS, AND DAMAGED LINKAGE.

5. LIST THE POSSIBLE CAUSES. WHAT TROUBLE SIGNS DID YOU FIND WHILE INSPECTING THE MACHINE? WHAT IS THE MOST LIKELY CAUSE OF TROUBLE? ARE THERE OTHER POSSIBILITIES? ONE FAILURE MAY LEAD TO ANOTHER.

6. REACH A CONCLUSION. REVIEW THE LIST OF POSSIBLE CAUSES AND DECIDE WHICH ARE THE EASIEST TO VERIFY. REACH YOUR DECISION ON THE LEADING CAUSES AND CHECK THEM OUT FIRST.

7. TEST YOUR CONCLUSION. TEST YOUR CONCLUSION TO SEE IF YOU ARE CORRECT BEFORE BEGINNING TO REPAIR THE SYSTEM. ANALYZE THE INFORMATION YOU ALREADY HAVE: WERE ALL THE HYDRAULIC FUNCTIONS BAD? IF SO, THE FAILURE IS PROBABLY IN A COMPONENT COMMON TO ALL PARTS IN THE SYSTEM. WAS ONLY ONE CIRCUIT BAD? IF SO, YOU CAN ELIMINATE THE SYSTEM COMPONENTS AND CONCENTRATE ON THAT ONE CIRCUIT.

---

[7] FUNDAMENTALS OF SERVICE - HYDRAULICS. OPCIT.

Appendix B

Instructional Materials

Handouts

H-1: Hydraulic Facts

H-2: Safety Rules for Hydraulics

H-3: Troubleshooting Guide

H-4: Maintenance Record

Transparencies

T-1 - 4: Principles of Hydraulics

T-5 - 8: Basic Hydraulic System

T-9: Basic Hydraulic Facts

T-10 - 13: Hydraulic Cylinders

T-14: Hydraulic Filtering Systems

T-15: Properties of Hydraulic Fluids

T-16: Fluid Contamination

T-17 - 19: Maintenance Problems

T-20: Safety Rules for Hydraulics

T-21: Hydraulic Testing Procedure

HYDRAULIC FACTS[8]

Here are some key facts that will help you understand hydraulics:

1. Hydraulic power is nearly always generated from mechanical power. Example: A hydraulic pump driven by an engine crankshaft.
2. Hydraulic power output is nearly always achieved by converting back to mechanical energy. Example: A cylinder which raises a heavy plow.
3. There are three types of hydraulic energy:
   a) potential or pressure energy;
   b) kinetic energy, the energy of moving liquids;
   c) heat energy, the energy of resistance to flow, or friction.
4. Hydraulic energy is neither created nor destroyed, only converted to another form.
5. All energy put into a hydraulic system must come out either as work (gain) or as heat (loss).
6. When a moving liquid is restricted, heat is created and there is a loss of potential energy (pressure) for doing work. Example: A tube or hose that is too small or is restricted. Orifices and relief valves are also restrictions but they are purposely designed into systems.
7. Flow through an orifice or restriction causes a pressure drop.
8. Oil must be confined to create pressure for work. A tightly sealed system is a must in hydraulics.
9. Oil takes the course of least resistance.

---

[8] Fundamentals of Service - Hydraulics. Moline, Illinois: Deere and Company. Second Edition, 1972.

SAFETY RULES FOR HYDRAULICS[9]

1. Always lower the hydraulic working units to the ground before leaving the machine.
2. Park the machinery where children cannot easily reach it.
3. Block up the working units when you must work on the system while raised. Do not rely on the hydraulic lift.
4. Never service the hydraulic system while the machine's engine is running unless absolutely necessary, as for bleeding the system.
5. Do not remove cylinders until the working units are resting on the ground or securely on safety stands or blocks. Also shut off the machine's engine.
6. When transporting the machine, lock the cylinder stops to hold the working units solidly in place.
7. Before disconnecting oil lines, 1) relieve all hydraulic pressure and 2) discharge the accumulator (if used).
8. Be sure all line connections are tight and lines are not damaged. Escaping oil under pressure is a fire hazard and can cause personal injury.
9. Some hydraulic pumps and control valves are heavy. Before removing them, provide a means of support such as a chain hoist, floor jack, or blocks.
10. When washing parts, use a nonvolatile cleaning solvent.
11. To insure control of the unit, keep the hydraulics in proper adjustment.

---

[9] Fundamentals of Service - Hydraulics. Moline, Illinois: Deere and Company. Second Edition, 1972.

TROUBLE SHOOTING GUIDE

Complaint	Observation or Symptom	Likely Source of Trouble	Probable Cause	Corrective Action Required
System does not work. No noise from relief valve(s).	Nothing happens--pump does not operate.	Pump shaft or drive broken.	Out of alignment.	Replace pump shaft or drive.
		Pump failure.	Faulty pump, or operator abuse.	Repair or replace pump. Review operating procedures.
	Pump operates, but piston does not move.	Pump worn out.	Normal wear. Improper servicing. Operator abuse.	Repair or replace pump. Follow proper service procedures. Check system load capacity.
		Control valve broken, stuck or improperly adjusted.	Too tight, out of alignment.	Check, clean and/or replace control valve.
		Wrong operating procedures.	Controls not operated properly.	Review operating procedures.
		Fluid low.	External leaks.	Add fluid. Check for leaks and repair.
	Pump operates, but piston does not move, it moves too slowly, or it is jerky and erratic.	Air in system (Foamy fluid).	Air leak or after working on system.	Repair, and bleed air from system.
		Pump speed too slow.	Engine speed too slow.	Check operating speed and correct.
		Wrong replacement pump installed.	Pump displacement too low.	Replace with correct pump.
		Pump screen restricted.	Need servicing.	Service system.
		Internal fluid leak(s).	Normal wear or broken parts. Seal failure.	Repair.
System does not work. Noise from relief valve(s).	Pump operates but piston does not move, or moves too slowly.	Filter clogged.	Cold Temperature.	Allow to warm up.
		Fluid cold.	Needs servicing.	Service system.
		Equipment binding.	Mechanical interference. Linkage warped. Tie downs intact.	Check and adjust.
		Load too heavy.	Overloaded.	Check load capacity.

[10] *Hydraulics Care and Operation*. Athens, Georgia: American Association for Vocational Instruction Materials, 1974.

TROUBLE SHOOTING GUIDE (Continued)

Complaint	Observation or Symptom	Likely Source of Trouble	Probable Cause	Corrective Action Required
System does not work. Noise from relief valve(s).	Pump operates but piston does not move, or moves too slowly.	Relief valve.	Spring broken, valve or seat damaged, or out of adjustment.	Check and repair.
		Clogged orifice.	Dirt.	Clean.
		Valves sticking.	Rust, wear, nicks.	Check and repair.
System works, but in wrong direction. No noise from relief valve(s).	Cylinder retracts when it should extend, extends when it should retract.	Hose or line connections.	Connections reversed.	Attach lines correctly.
		Control valves not operated properly.	Wrong operating procedure.	Review operating procedures.
System operates too fast. No noise from relief valve(s).	Cylinder extends and/or retracts too fast.	Orifice valve.	Orifice worn.	Repair or replace.
		Flow control valve.	Flow control valve spring broken or out of adjustment.	Repair or replace.
		Incorrect replacement pump. Too much displacement.	Wrong choice of replacement pump.	Replace with correct pump.
		Pump speed too fast.	Engine speed too fast.	Reduce engine speed to correct specifications.
Will not support the load. No noise from relief valve(s).	Load drops when control is in neutral.	Control lever not centering.	Worn or damaged linkage or springs.	Repair or replace linkage.
		External leak.	Worn seals, bad gaskets, or loose fittings.	Look for leaks. Repair or replace.
		Internal leak. Circuit relief valve leaking.	Worn parts.	Repair or replace.
		Control valve worn.	Worn parts.	Repair or replace.
		Piston seals.	Scored cylinder or piston rod, or faulty seals.	Repair or replace.
verheating o noise from lief valve(s).	Slow operation.	Fluid type.	Wrong type of fluid.	Check fluid specifications.
		Dirty fluid.	Fluid needs changing.	Change fluid.

TROUBLE SHOOTING GUIDE (Continued)

Complaint	Observation or Symptom	Likely Source of Trouble	Probable Cause	Corrective Action Required
Overheating No noise from relief valve(s).	Burned odor. Charred paint. Fluid foamy.	Cooling fan not working.	Belt slipping or fan shaft broken.	Check fan operations and repair.
		Internal damage.	Worn parts.	Repair or replace.
		Cooler clogged.	Fins clogged.	Clean.
		Fluid level low.	External leak. Internal leak.	Look for leaks and repair.
Overheating. Noise from relief valve(s).	Slow operation. Burned odor. Charred paint.	Operating procedures.	Operator holds control valve in power position too long.	Review operation procedures.
		Load too heavy.	Over loading.	Check load capacity.
Overheating Noise from relief valve(s).	Fluid foamy.	Engine or pump operating too fast.	Engine speed too fast or pump and engine mismatched.	Check operating speeds. Check pump requirements and replace.
		Relief valve out of adjustment.	Needs adjusting.	Check and adjust.
		Internal restriction.	Dirt in orifice.	Clean.
System continues to break down.	Mechanical breakage, ruptured lines, hoses and bent rods.	Pump relief valve.	Pressure setting too high.	Adjust.
Noisy pump.	Pump whines.	Foamy fluid.	Wrong specifications.	Replace fluid.
		Filter.	Needs servicing.	Service System.
		Fluid.	Fluid low.	Service system.
	Mechanical noise.	Restriction in pump suction line.	Dirt, or kinked or collapsed line.	Clean, repair or replace.
		Pump drive.	Normal wear, or out of alignment.	Repair.

MAINTENANCE RECORD

Equipment____________________ Model________________ Year _________

Symptom Date________

Description of Investigation Date________

Corrective Action Date________

Repairs Made Date________

Length of Downtime Date________

Fluid Changed____ Date______

Filter Changed____ Date______

Replace Strainer__ Date______

Cleaned Strainer__ Date______

Fluid Added ____ Date______

Fluid Changed ____ Date______

Filter Changed____ Date______

Replace Strainer__ Date______

Cleaned Strainer__ Date______

Fluid Added ____ Date______

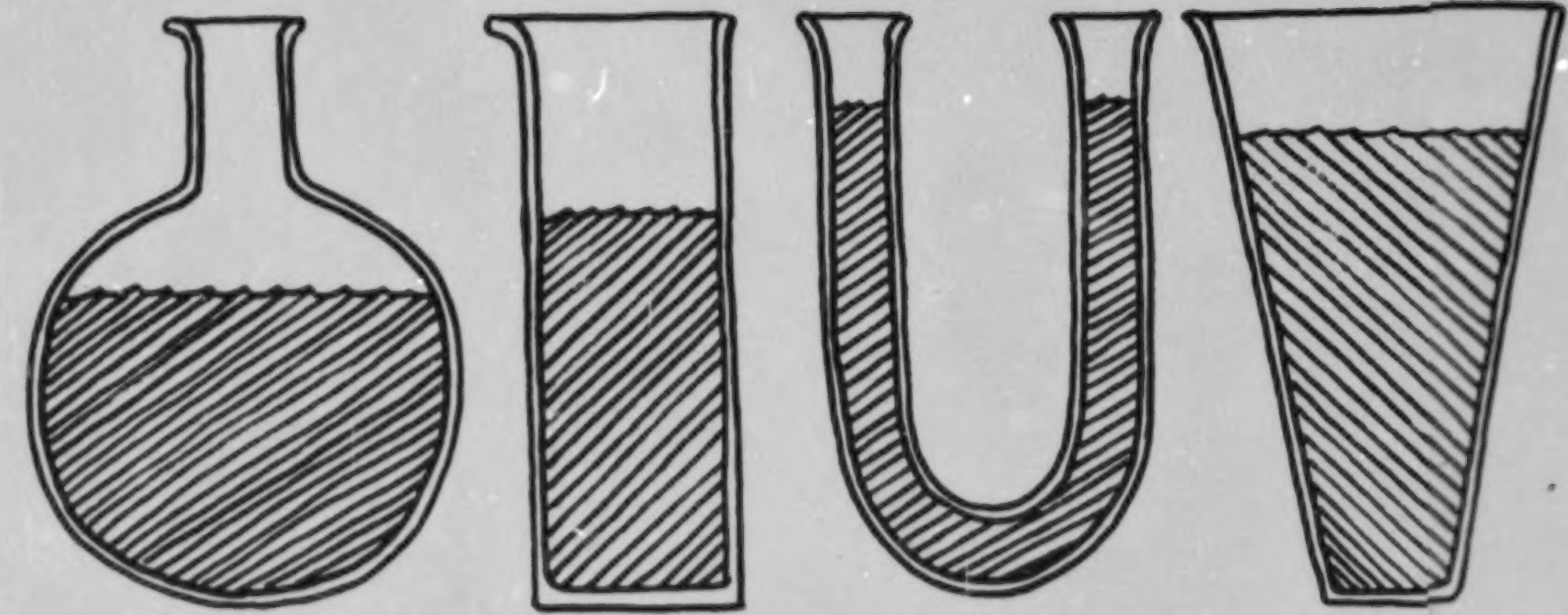
Fluid Changed____ Date______

Filter Changed____ Date______

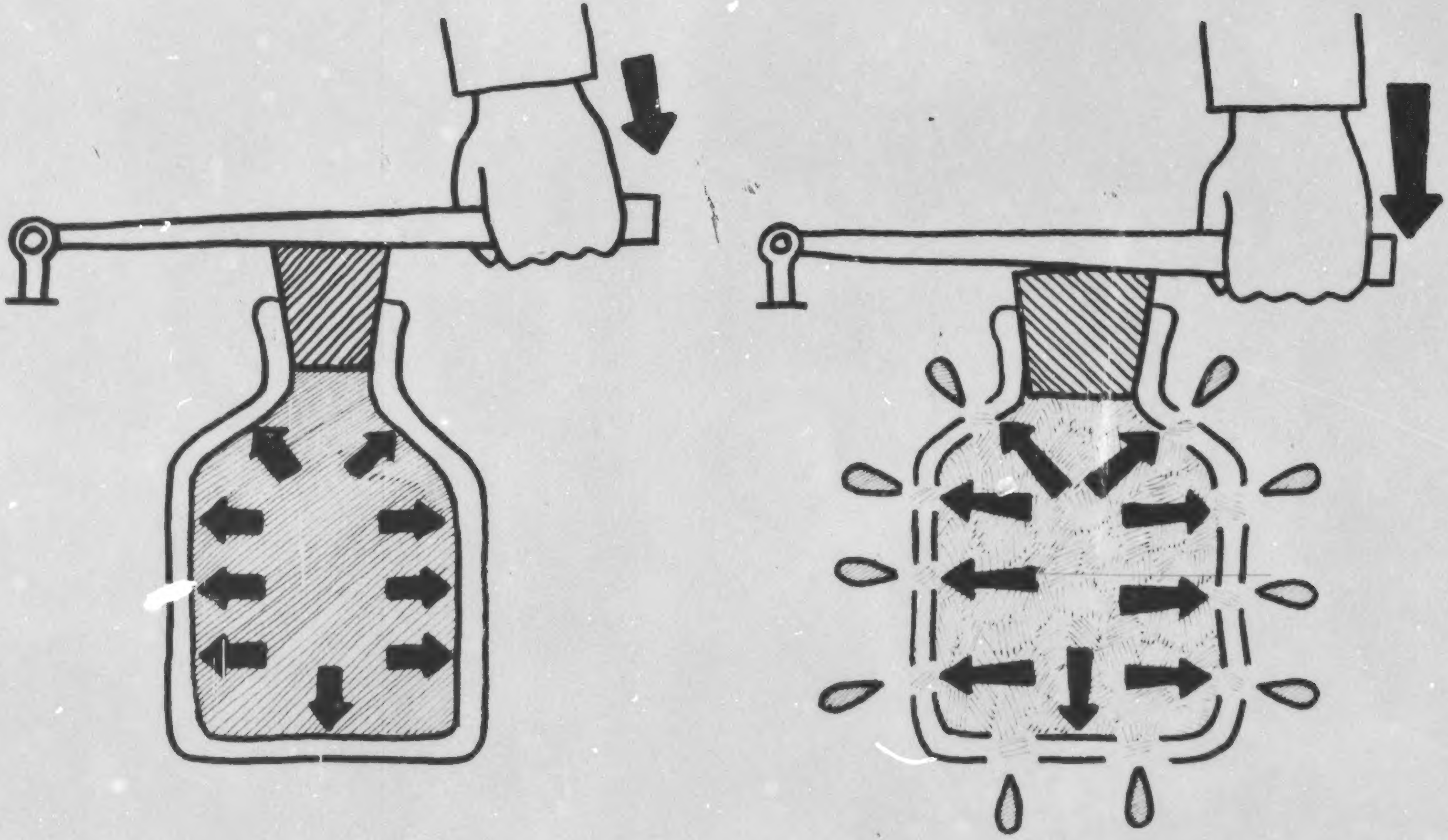
Replace Strainer__ Date______

Cleaned Strainer__ Date______

Fluid Added ____ Date______

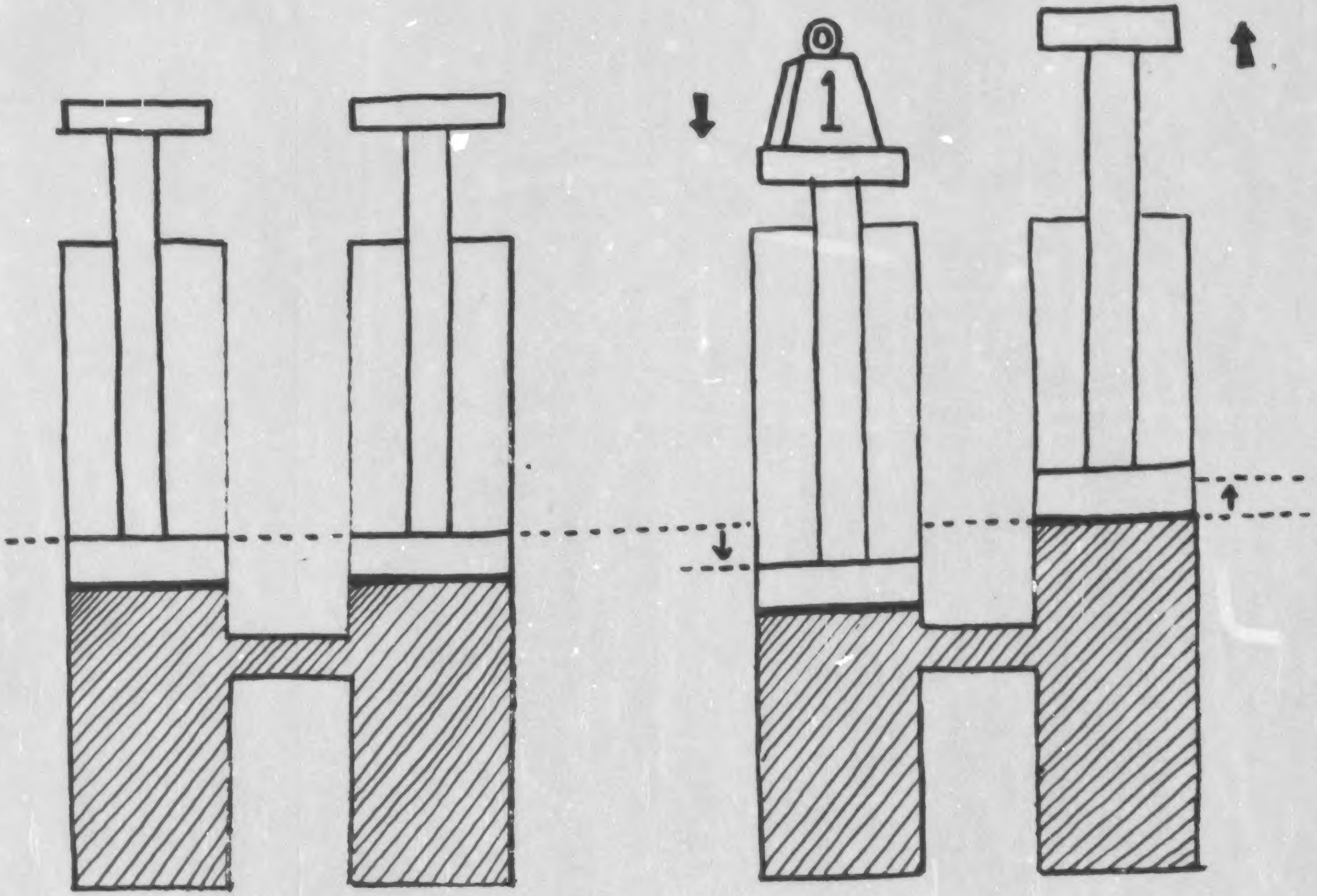


LIQUIDS HAVE NO SHAPE OF THEIR OWN

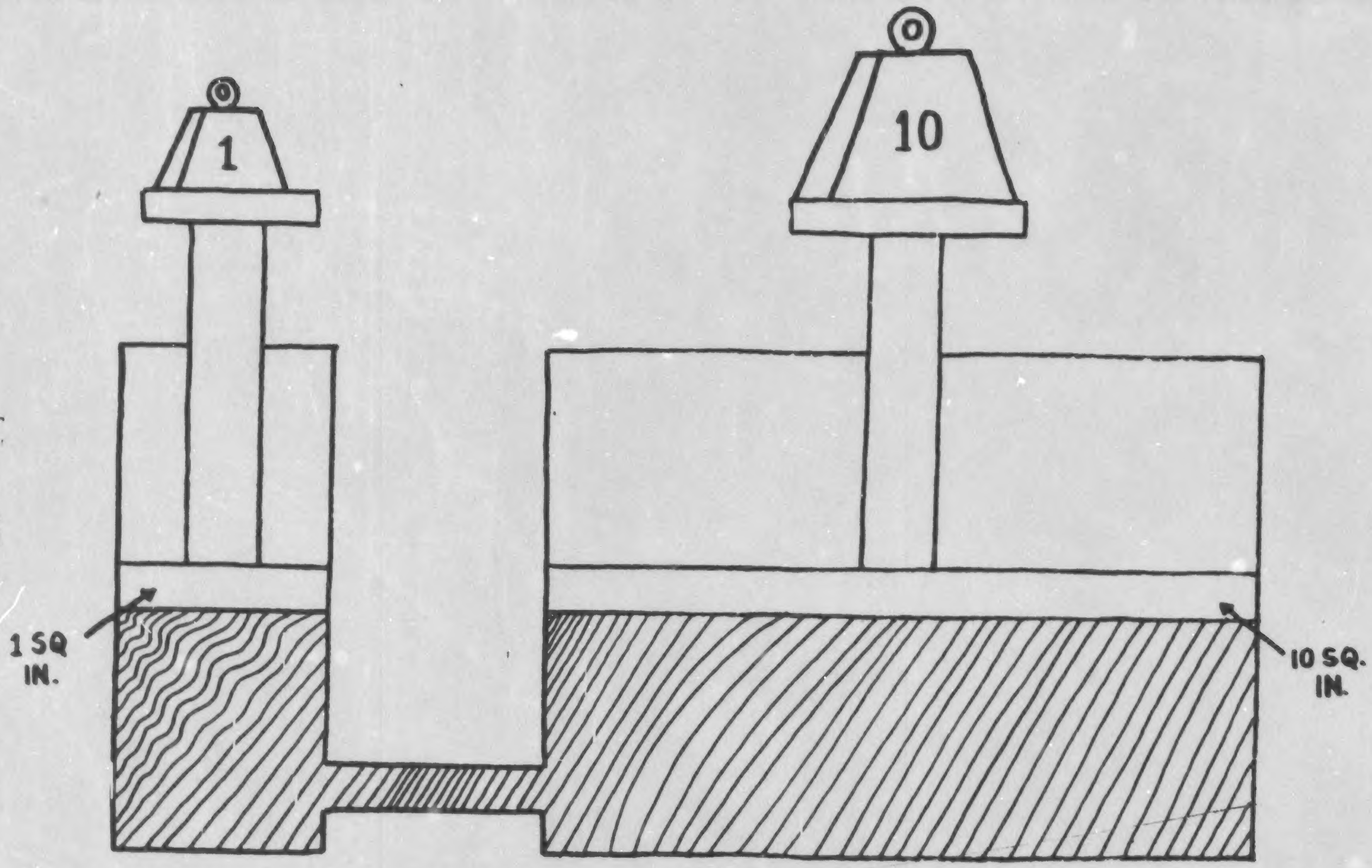


LIQUIDS WILL NOT COMPRESS

T-2

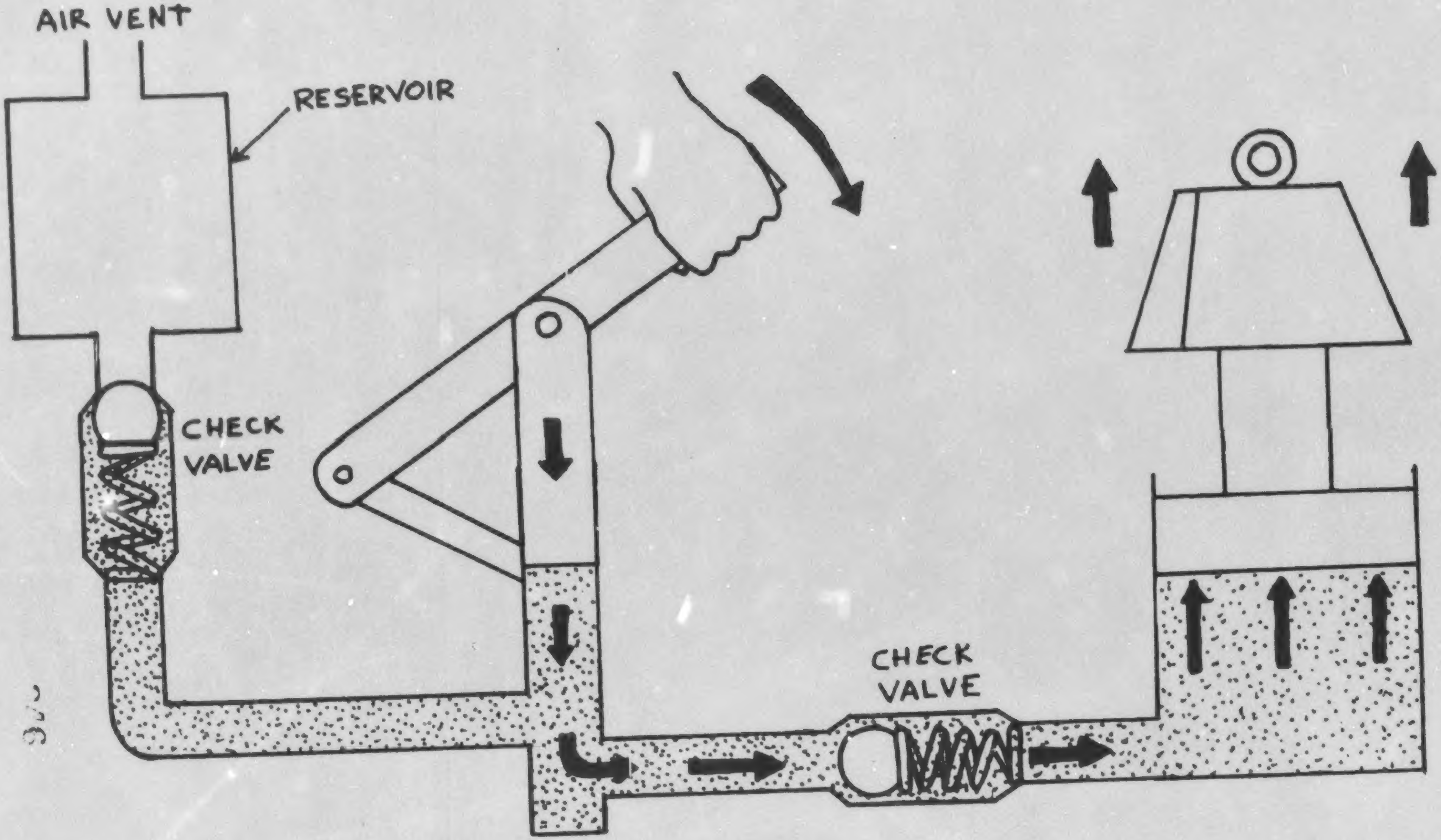


LIQUIDS TRANSMIT APPLIED PRESSURE IN ALL DIRECTIONS

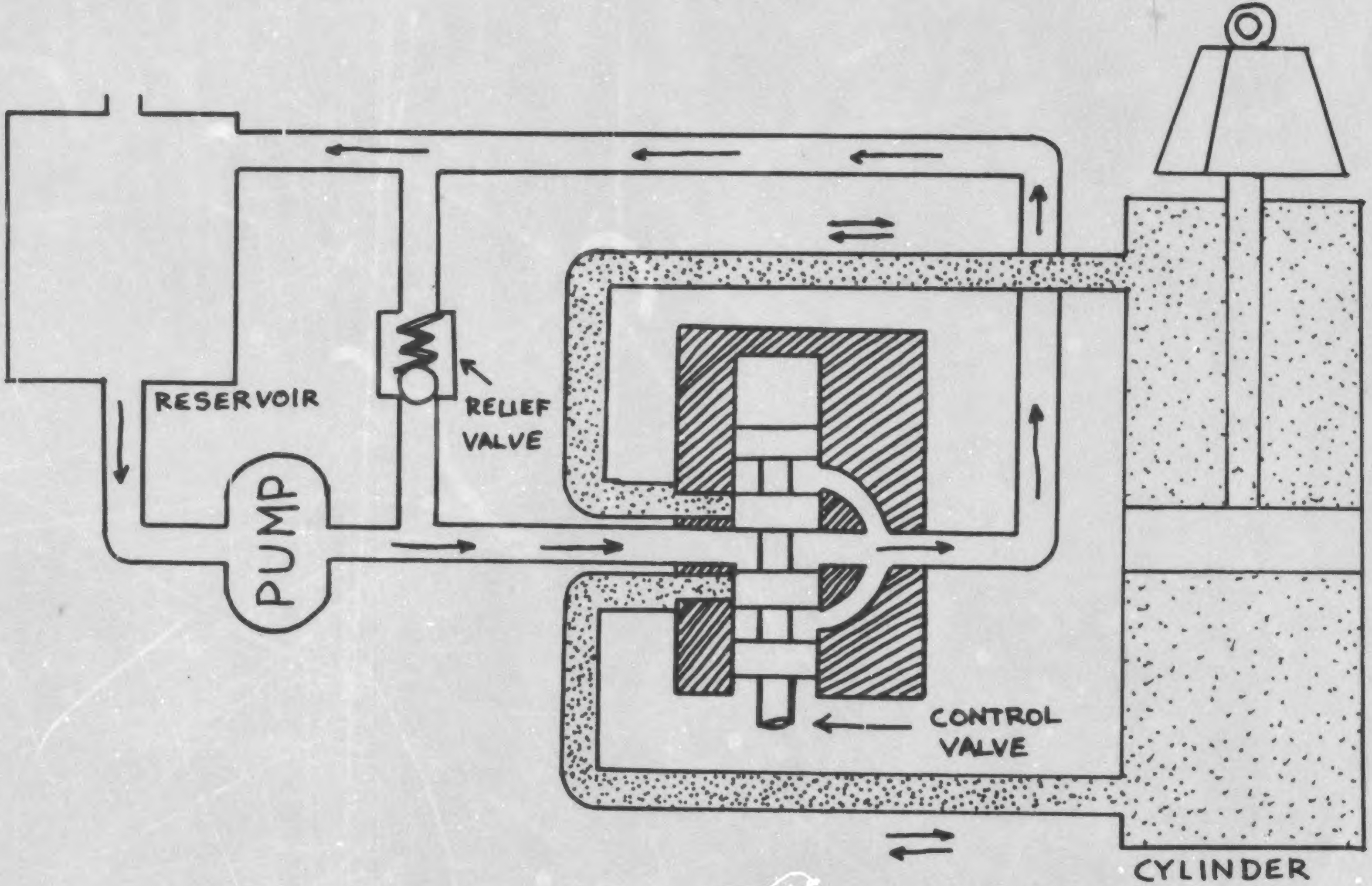

1
10
1 SQ IN.
10 SQ. IN.

LIQUIDS PROVIDE GREAT INCREASES IN WORK FORCE

T-4

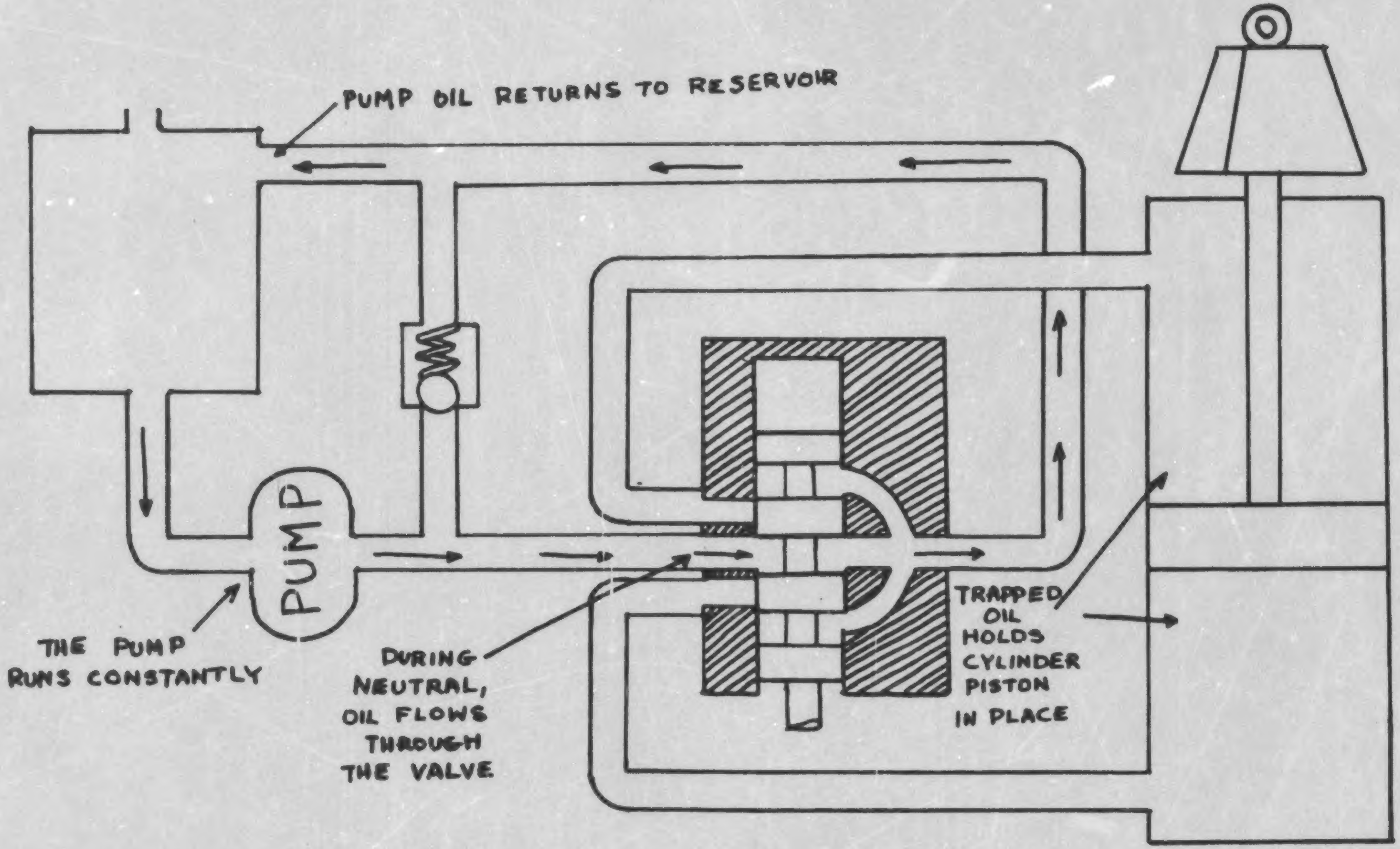

AIR VENT
RESERVOIR
CHECK VALVE
CHECK VALVE

HYDRAULIC SYSTEM WITH RESERVOIR AND CHECK VALVES ADDED

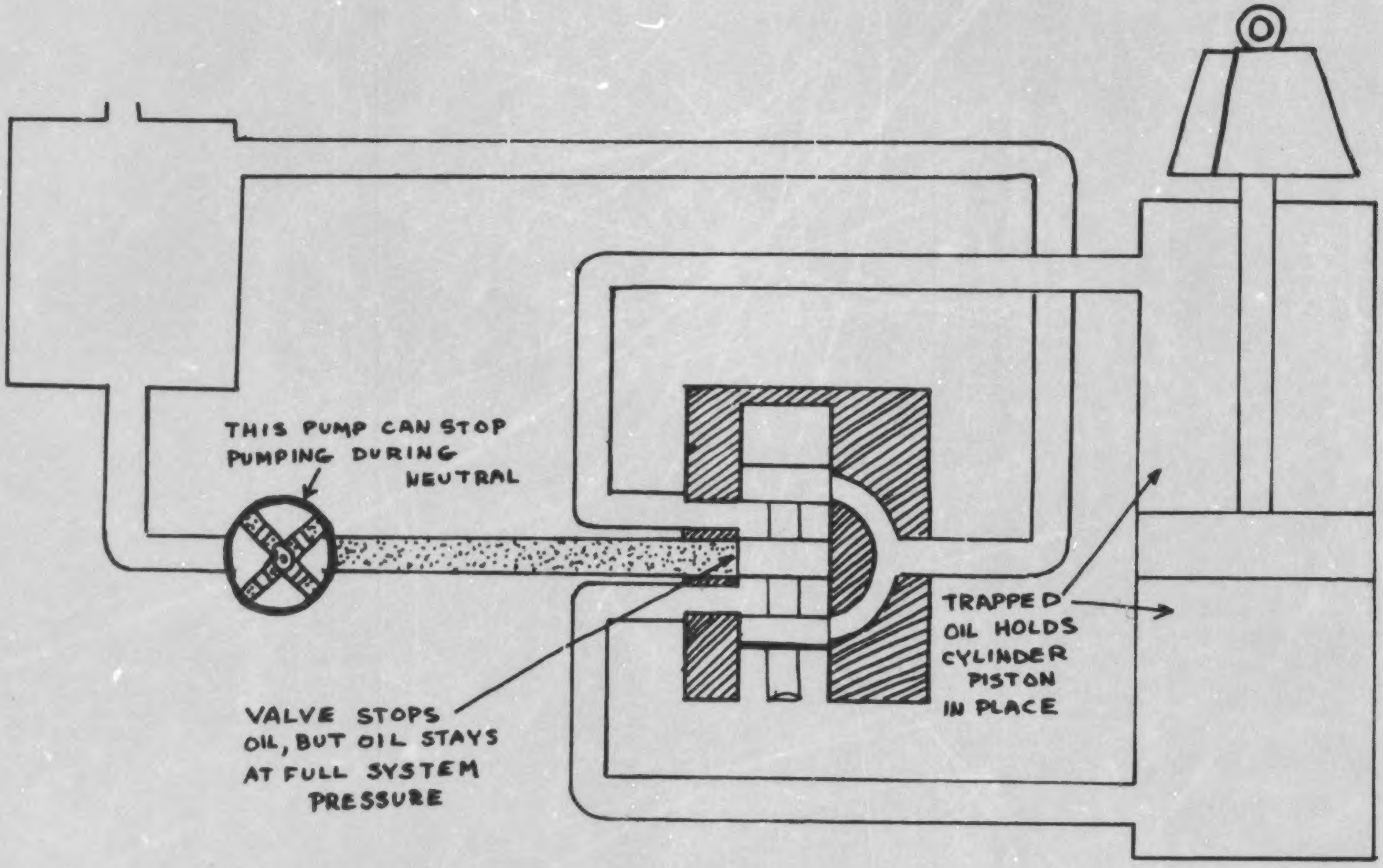

RESERVOIR
RELIEF VALVE
PUMP
CONTROL VALVE
CYLINDER

HYDRAULIC SYSTEM WITH RELIEF VALVE, FOUR-WAY CONTROL VALVE, AND DOUBLE-ACTING CYLINDER ADDED

T-6


PUMP OIL RETURNS TO RESERVOIR
PUMP
THE PUMP RUNS CONSTANTLY
DURING NEUTRAL, OIL FLOWS THROUGH THE VALVE
TRAPPED OIL HOLDS CYLINDER PISTON IN PLACE

OPEN-CENTER SYSTEM IN NEUTRAL


THIS PUMP CAN STOP PUMPING DURING NEUTRAL
VALVE STOPS OIL, BUT OIL STAYS AT FULL SYSTEM PRESSURE
TRAPPED OIL HOLDS CYLINDER PISTON IN PLACE

CLOSED-CENTER SYSTEM IN NEUTRAL

T-8

HYDRAULIC FACTS[11]

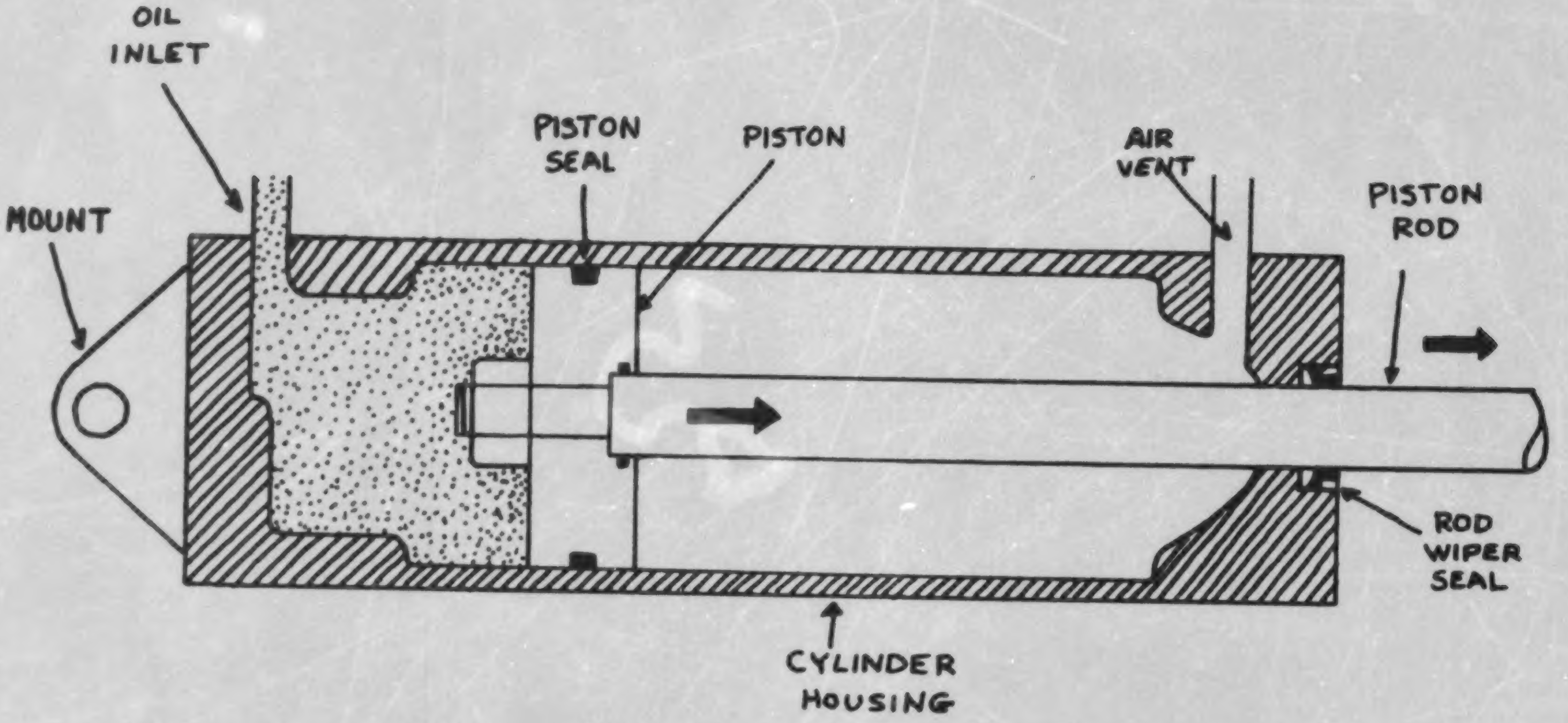
HERE ARE SOME KEY FACTS THAT WILL HELP YOU UNDERSTAND HYDRAULICS:

1. HYDRAULIC POWER IS NEARLY ALWAYS GENERATED FROM MECHANICAL POWER. EXAMPLE: A HYDRAULIC PUMP DRIVEN BY AN ENGINE CRANKSHAFT.
2. HYDRAULIC POWER OUTPUT IS NEARLY ALWAYS ACHIEVED BY CONVERTING BACK TO MECHANICAL ENERGY. EXAMPLE: A CYLINDER WHICH RAISES A HEAVY PLOW.
3. THERE ARE THREE TYPES OF HYDRAULIC ENERGY:
   A) POTENTIAL OR PRESSURE ENERGY;
   B) KINETIC ENERGY, THE ENERGY OF MOVING LIQUIDS; AND
   C) HEAT ENERGY, THE ENERGY OF RESISTANCE TO FLOW, OR FRICTION.
4. HYDRAULIC ENERGY IS NEITHER CREATED NOR DESTROYED, ONLY CONVERTED TO ANOTHER FORM.
5. ALL ENERGY PUT INTO A HYDRAULIC SYSTEM MUST COME OUT EITHER AS WORK (GAIN) OR AS HEAT (LOSS).
6. WHEN A MOVING LIQUID IS RESTRICTED, HEAT IS CREATED AND THERE IS A LOSS OF POTENTIAL ENERGY (PRESSURE) FOR DOING WORK. EXAMPLE: A TUBE OR HOSE THAT IS TOO SMALL OR IS RESTRICTED. ORIFICES AND RELIEF VALVES ARE ALSO RESTRICTIONS BUT THEY ARE PURPOSELY DESIGNED INTO SYSTEMS.
7. FLOW THROUGH AN ORIFICE OR RESTRICTION CAUSES A PRESSURE DROP.
8. OIL MUST BE CONFINED TO CREATE PRESSURE FOR WORK. A TIGHTLY SEALED SYSTEM IS A MUST IN HYDRAULICS.
9. OIL TAKES THE COURSE OF LEAST RESISTANCE.

---

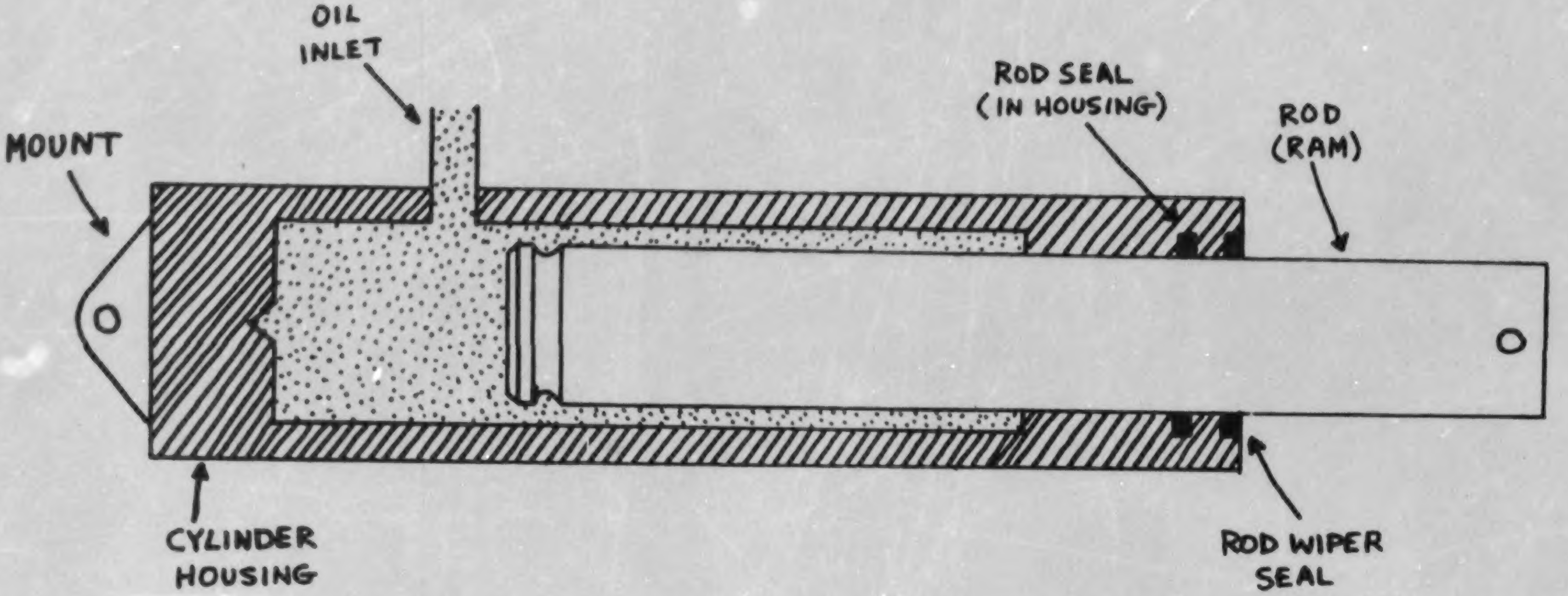
[11] FUNDAMENTALS OF SERVICE - HYDRAULICS. MOLINE, ILLINOIS: DEERE AND COMPANY. SECOND EDITION, 1972.

10. Oil is normally pushed into a pump, not drawn into it. (Atmospheric pressure supplies this push. For this reason, an air vent is needed in the top of the reservoir.)
11. A pump does not pump pressure; it creates flow. Pressure is caused by resistance to flow.
12. Two hydraulic systems may produce the same power output - one at high pressure and low flow, the other at low pressure and high flow.
13. A basic hydraulic system must include four components: A reservoir to store the oil; a pump to push the oil through the system; valves to control oil pressure and flow; and a cylinder (or motor) to convert the fluid movement into work.
14. Compare the two major hydraulic systems:
    Open-Center System = pressure is varied but flow is constant.
    Closed-Center System = flow is varied but pressure is constant.
15. There are two basic types of hydraulics:
    a) Hydrodynamics is the use of fluids at high speeds "on impact" to supply power. Example: A torque converter.
    b) Hydrostatics is the use of fluids at relatively low speeds but at high pressures to supply power. Example: most hydraulic systems, and all those covered in this manual.

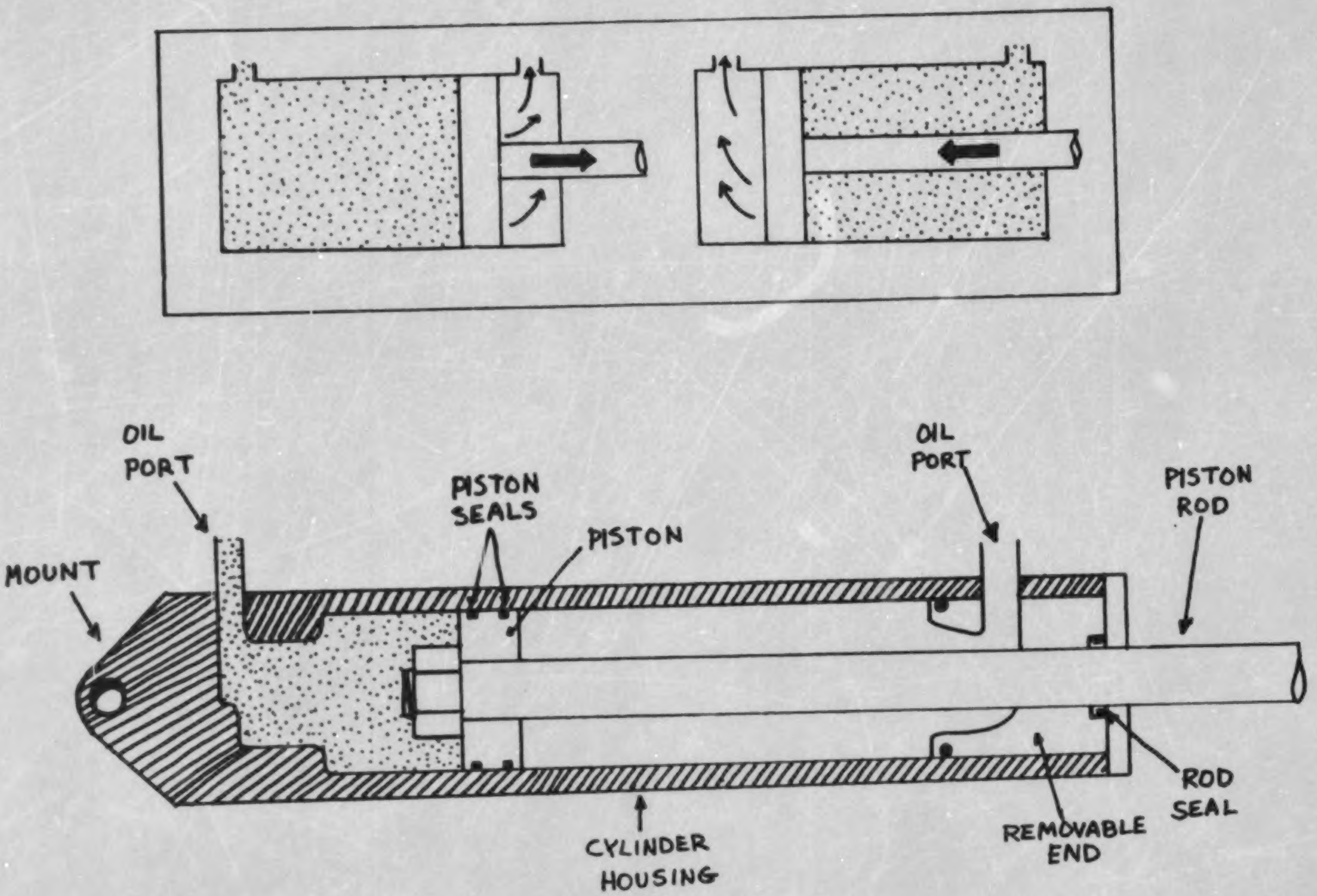

OIL INLET
MOUNT
PISTON SEAL
PISTON
AIR VENT
PISTON ROD
ROD WIPER SEAL
CYLINDER HOUSING

A TYPICAL SINGLE-ACTING CYLINDER

T-10

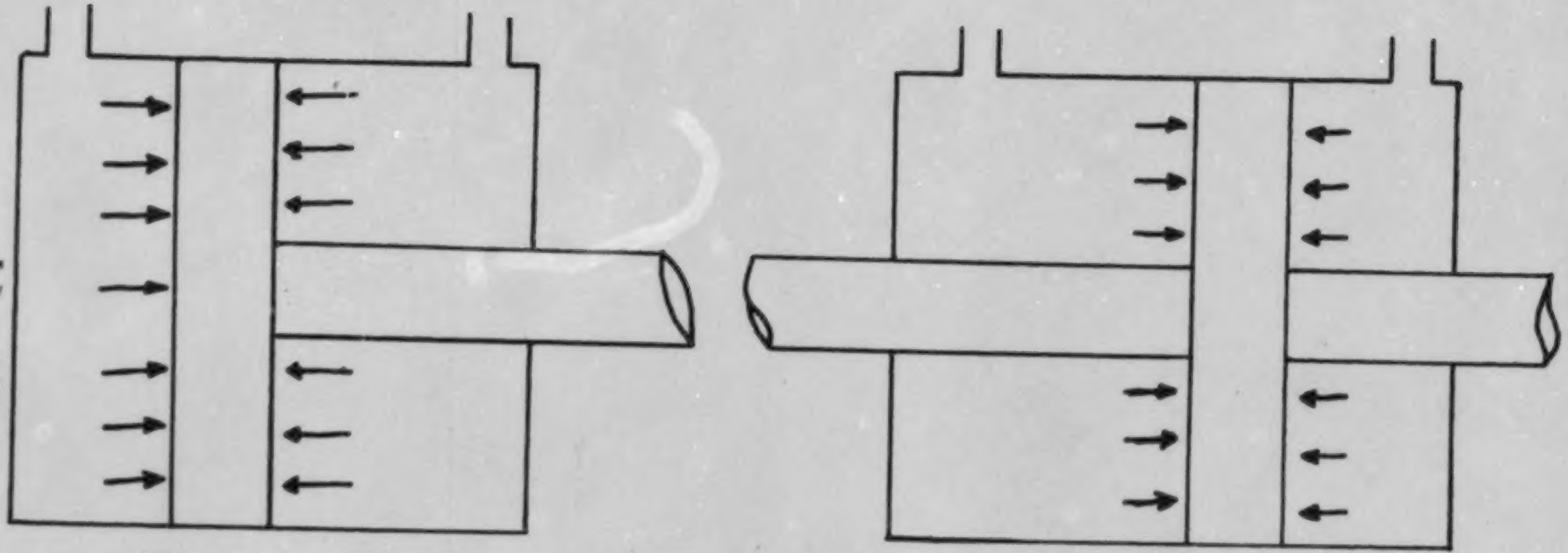

OIL INLET
MOUNT
ROD SEAL (IN HOUSING)
ROD (RAM)
CYLINDER HOUSING
ROD WIPER SEAL

RAM-TYPE CYLINDER


OIL
PORT
MOUNT
PISTON
SEALS
PISTON
OIL
PORT
PISTON
ROD
CYLINDER
HOUSING
REMOVABLE
END
ROD
SEAL

A TYPICAL DOUBLE-ACTING CYLINDER

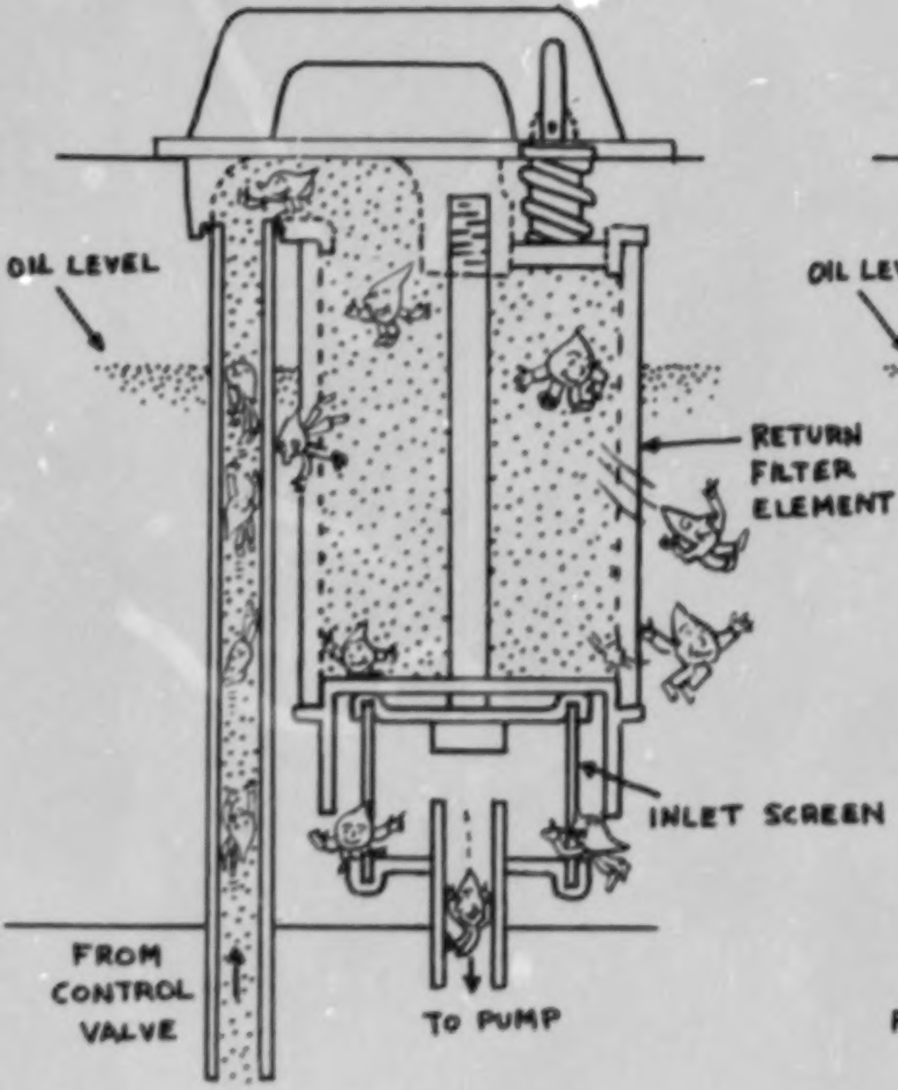
T-12



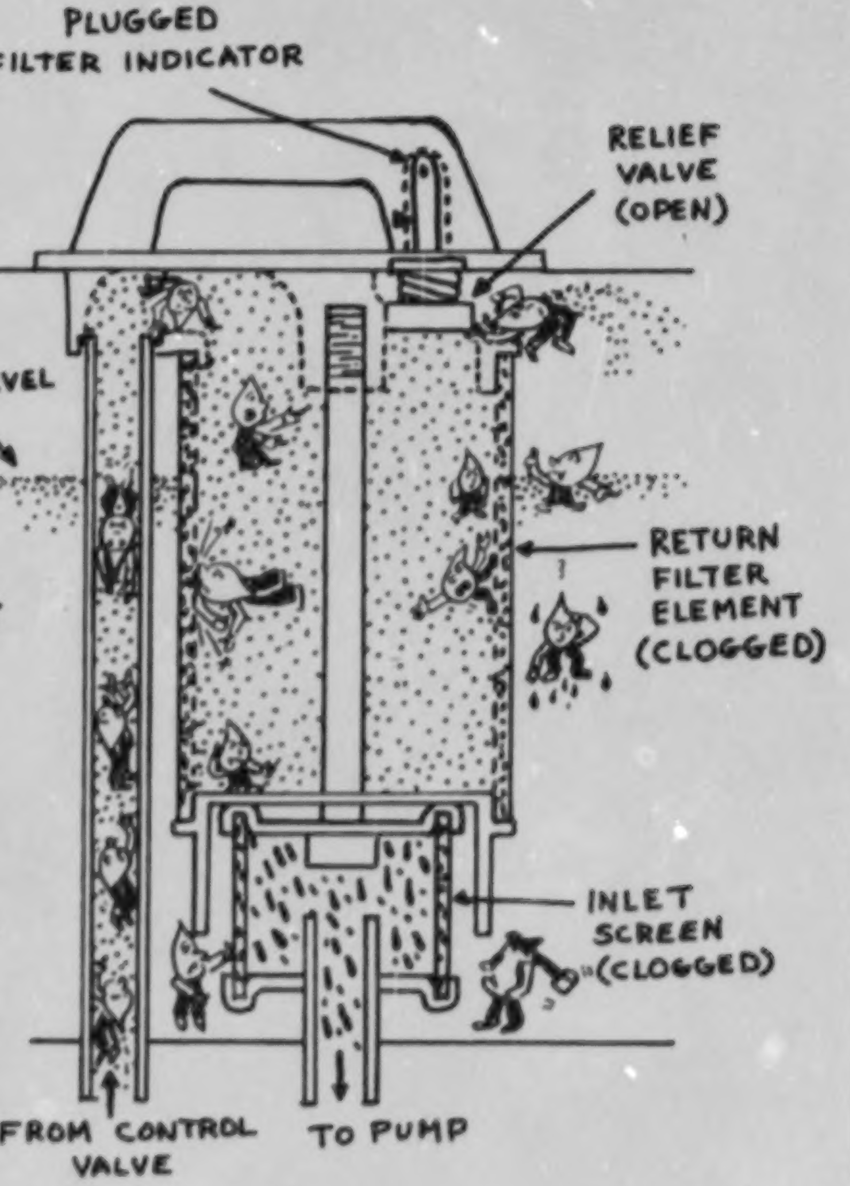
UNBALANCED
(DIFFERENTIAL TYPE)

BALANCED
(EQUAL FORCE BOTH WAYS)

TWO TYPES OF DOUBLE-ACTING CYLINDERS


OIL LEVEL
RETURN FILTER ELEMENT
INLET SCREEN
FROM CONTROL VALVE
TO PUMP

FULL-FLOW HYDRAULIC SYSTEM FILTERS


PLUGGED FILTER INDICATOR
RELIEF VALVE (OPEN)
OIL LEVEL
RETURN FILTER ELEMENT (CLOGGED)
INLET SCREEN (CLOGGED)
FROM CONTROL VALVE
TO PUMP

HYDRAULIC FILTER RELIEF VALVE

FLUID PROPERTIES

VISCOSITY

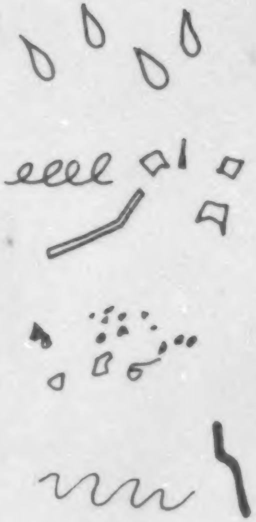
1) MINIMUM VISCOSITY INDEX
2) STANDARD TEST TEMPERATURE, 100°F

OIL OXIDATION RATE

INCREASES IN DIRECT PROPORTION TO THE TEMPERATURE AND PERCENTAGE OF CONTAMINANTS.

POUR POINT

MEASURES THE RELATIVE ABILITY OF THE OIL TO FLOW AT LOW TEMPERATURES.



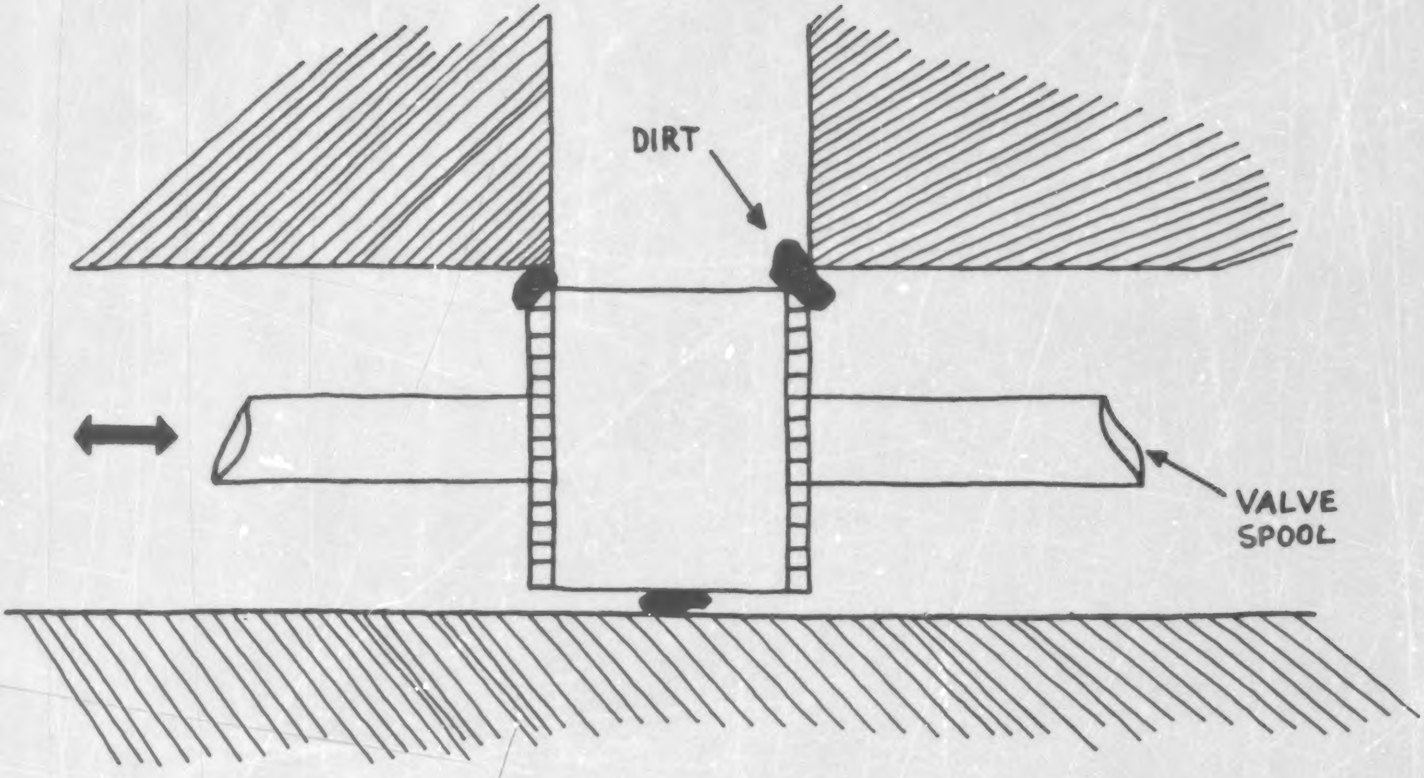
WATER, ACID

METAL BURRS
AND CHIPS

DUST, SAND, PIECES
OF SEALS AND PAINT

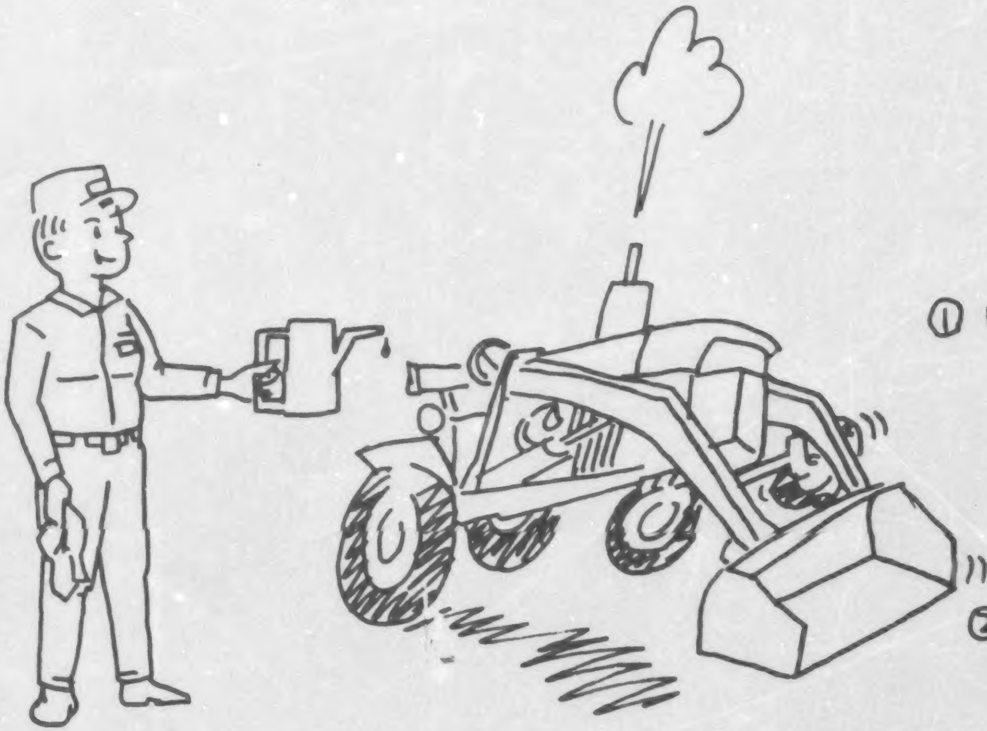
LINT, FIBERS

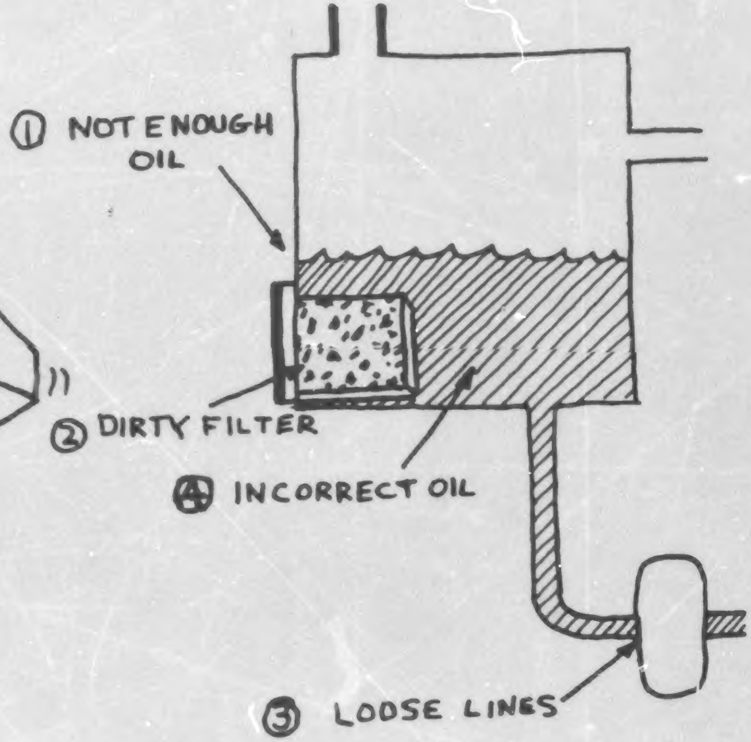
CONTAMINANTS


DIRT
VALVE SPOOL

DIRT WILL WEAR VALVE SPOOLS

T-17




① NOT ENOUGH OIL
② DIRTY FILTER
④ INCORRECT OIL
③ LOOSE LINES

HERE ARE THE KEY MAINTENANCE PROBLEMS:

1. NOT ENOUGH OIL IN THE RESERVOIR.
2. CLOGGED OR DIRTY OIL FILTERS.
3. LOOSE INTAKE LINES.
4. INCORRECT OIL IN THE SYSTEM.

WHAT IS GOOD MAINTENANCE?

- Use Common Sense
- Stop, Look, Touch, Listen Before Picking Up Tools
- Keep Parts Clean
- Change Oil and Filters Regularly
- Maintain Good Records

GOOD GUYS	BAD GUYS
1. Cleanliness	1. Dirt
2. High Quality Oil	2. Water
3. Proper Filters	3. Air
4. Tight Seals	4. Heat
5. Normal Operation	5. Abuse

SAFETY RULES FOR HYDRAULICS[12]

1. Always lower the hydraulic working units to the ground before leaving the machine.
2. Park the machinery where children cannot easily reach it.
3. Block up the working units when you must work on the system while raised. Do not rely on the hydraulic lift.
4. Never service the hydraulic system while the machine's engine is running unless absolutely necessary, as for bleeding the system.
5. Do not remove cylinders until the working units are resting on the ground or securely on safety stands or blocks. Also shut off the machine's engine.
6. When transporting the machine, lock the cylinder stops to hold the working units solidly in place.
7. Before disconnecting oil lines, 1) relieve all hydraulic pressure and 2) discharge the accumulator (if used).
8. Be sure all line connections are tight and lines are not damaged. Escaping oil under pressure is a fire hazard and can cause personal injury.
9. Some hydraulic pumps and control valves are heavy. Before removing them, provide a means of support such as a chain hoist, floor jack, or blocks.
10. When washing parts, use a nonvolatile cleaning solvent.
11. To insure control of the unit, keep the hydraulics in proper adjustment.

---

[12] *Fundamentals of Service - Hydraulics*. Moline, Illinois: Deere and Company, Second Edition, 1972.

DIAGNOSIS AND TESTING OF HYDRAULIC SYSTEMS[13]

1. Know the System
2. Ask the Operator
3. Operate the Machine
4. Inspect the Machine
5. List the Causes
6. Reach a Conclusion
7. Test Your Conclusion

---

[13] Fundamentals of Service - Hydraulics. Moline, Illinois: Deere and Company, Second Edition, 1972.

ADULT UNIT NO. 12

PLANNING THE FARM SERVICE CENTER

A RESOURCE UNIT FOR ADULT EDUCATION CLASSES IN AGRICULTURE

DEVELOPED BY
WAYNE LONGBRAKE

EDITED BY
L. H. NEWCOMB

DEPARTMENT OF AGRICULTURAL EDUCATION
COLLEGE OF AGRICULTURE AND HOME ECONOMICS
THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO 43210

1975

PREFACE

THIS RESOURCE UNIT WAS DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U. S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN
ASSISTANT PROFESSOR

L. H. NEWCOMB
ASSISTANT PROFESSOR

TABLE OF CONTENTS

PAGE

PREFACE III

INTRODUCTION 1

STATE SITUATION 3

LOCAL SITUATION 3

OBJECTIVES 3

REFERENCES 3

NEEDED AV EQUIPMENT 3

ALTERNATIVE INTEREST APPROACHES 4

QUESTIONS TO BE ANSWERED 4

LEARNING ACTIVITIES 4

APPENDIX A: CONTENT SUMMARY 6

APPENDIX B: INSTRUCTIONAL MATERIALS 11

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATIBLE TO THE LOCAL COMMUNITY.

PLANNING THE FARM SERVICE CENTER

STATE SITUATION

THE DEVELOPMENT OF AGRICULTURAL TECHNOLOGY INDICATES NEW TRENDS IN MANAGEMENT AND SERVICE FACILITIES. THE INCREASING SIZE IN FARMS AND CAPITAL INVESTMENT IN MACHINERY AND POWER UNITS ALONG WITH FARM PRICES LOWER THAN THE OVERALL ECONOMY ARE REQUIRING THE PRODUCER TO OPERATE WITH GREATER EFFICIENCY.

LOCAL SITUATION (NOTE TO TEACHER)

SURVEY YOUR COMMUNITY TO DETERMINE THE NUMBER OF FULL-TIME FARMING OPERATIONS, EQUIPMENT REPAIR COST AND TOTAL DOWNTIME TO ASSESS THE NEEDS OF THE COMMUNITY.

OBJECTIVES

THE LEARNER IS TO:

1. DETERMINE THE ECONOMIC NEED FOR A FARM SERVICE CENTER.
2. SELECT THE SIZE AND LOCATION OF A SERVICE CENTER.
3. PLAN THE ARRANGEMENT OF THE SERVICE CENTER.
4. DEVELOP AN EQUIPMENT LIST FOR THE SERVICE CENTER.

REFERENCES

PLANNING A FARM SHOP LAYOUT. SOUTHERN ASSOCIATION FOR AGRICULTURAL ENGINEERING AND VOCATIONAL AGRICULTURE. ATHENS, GEORGIA.

PLANNING AND EQUIPPING A SERVICE CENTER FOR YOUR FARM. IOWA STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY. COOPERATIVE EXTENSION SERVICE. AMES, IOWA. APRIL, 1972.

SHOP PLANNING: BASIC DESIGN OF SHOPS AND SERVICE CENTERS. AMERICAN ASSOCIATION FOR VOCATIONAL INSTRUCTIONAL MATERIALS. ATHENS, GEORGIA: 1975.

NEEDED AV EQUIPMENT

OVERHEAD PROJECTOR, SCREEN.

ALTERNATIVE INTEREST APPROACHES

ALTERNATIVE A. IT HAS BEEN ESTIMATED THAT FOR EVERY $100 OF VALUE OF A FARM BUILDING YOU WILL SPEND $4 FOR REPAIR. FOR MACHINERY YOU CAN FIGURE ON $8 FOR REPAIRS FOR EVERY $100 IT COSTS WHEN NEW.

ALTERNATIVE B. THE YEARLY MAINTENANCE COST OF FARM MACHINERY SHOULD BE LARGE ENOUGH TO SHOW THAT SAVING PART OF THE COST WOULD PROVIDE CONSIDERABLE FINANCING OF A SERVICE CENTER.

COST OF MACHINERY REPAIR

	PARTS COST	TOTAL COST
1973		
1974		
1975		

TOTAL COST - PARTS COST = LABOR COST (THE AMOUNT SAVED BY A FARM SERVICE CENTER). REFER TO TRANSPARENCY #2 TO EMPHASIZE THE REPAIR COST TO BE SAVED BY PERFORMING YOUR OWN MAINTENANCE WORK. SUBTRACT COST OF PARTS FROM TOTAL COST TO DETERMINE SAVINGS.

ALTERNATIVE C. SHOW SLIDES OF SOME TYPICAL FARM SHOPS OR YOU COULD HOLD A GENERAL DISCUSSION WITH THE GROUP TO GET AT THE NEED TO SERIOUSLY CONSIDER ADDING A FARM SHOP OR UPGRADING AN EXISTING ONE.

QUESTIONS TO BE ANSWERED

1. DO I REALISTICALLY NEED A FARM SERVICE CENTER?
2. HOW DO I DETERMINE THE SERVICE CENTER LOCATION?
3. WHAT SIZE SERVICE CENTER WILL MEET MY NEEDS?
4. WHAT EQUIPMENT IS NEEDED IN THE SERVICE CENTER?
5. HOW DO I DEVELOP THE FLOOR PLAN?

LEARNING ACTIVITIES

1. DO I REALISTICALLY NEED A FARM SERVICE CENTER?

USE TRANSPARENCIES #1 & 2 TO DISCUSS THE ECONOMICAL NEED OF A SERVICE CENTER.

2. HOW DO I DETERMINE THE SERVICE CENTER LOCATION?

TRANSPARENCY #3 WILL AID IN DETERMINING THE SERVICE CENTER LOCATION.

3. WHAT SIZE SERVICE CENTER WILL MEET MY NEEDS?

MEASURE THE LENGTH AND WIDTH OF THE LARGEST EQUIPMENT YOU EXPECT TO SERVICE.

USE TRANSPARENCY #4 TO PROVIDE CRITERIA FOR DETERMINING THE SIZE OF THE SERVICE CENTER.

4. WHAT EQUIPMENT IS NEEDED IN THE SERVICE CENTER?

USE HANDOUT #1 TO DEVELOP LIST OF EQUIPMENT NEEDED IN THE SERVICE CENTER.

HAVE EACH CLASS MEMBER DEVELOP LIST OF EQUIPMENT NEEDED AND ON HAND.

5. HOW DO I ARRANGE THE WORK AREAS?

USE TRANSPARENCY #5 TO SHOW ARRANGEMENT OF SERVICE AREAS.

USE TRANSPARENCY #6 TO SHOW EQUIPMENT ARRANGEMENT.

TRANSPARENCY #7 MAY BE USED TO DEMONSTRATE ARRANGEMENT OF WORK AREAS (CUT OUT MASTER TEMPLATES AND PLACE ON TRANSPARENCY).

HAVE CLASS MEMBERS CUT OUT TEMPLATE H-3 OF THEIR SHOP EQUIPMENT AND ARRANGE INTO WORK AREAS AROUND THE SERVICE AREA AND WITHIN THE PREVIOUSLY DETERMINED FLOOR AREA ON H-3.

APPENDIX A

CONTENT SUMMARY

PLANNING THE FARM SERVICE CENTER[1]

THE FARM SERVICE CENTER SERVES THREE MAJOR PURPOSES:

FIRST, IT IS AN "INSURANCE POLICY" AGAINST TIME CONSUMING AND COSTLY REPAIRS OF EQUIPMENT BREAKDOWNS AND MALFUNCTIONS. SINCE MOST EQUIPMENT FAILURE OCCURS DURING CRITICAL PERIODS IT IS IMPORTANT TO BE ABLE TO MAKE EMERGENCY REPAIRS WHICH MAY RESULT IN CONSIDERABLE SAVINGS. USUALLY EMERGENCY REPAIRS ARE A MATTER OF BEING ABLE TO DRILL A HOLE, CUT THREADS ON A FITTING OR WELD A BROKEN PART. IN MANY CASES THIS MAY SAVE A TRIP TO TOWN, AND THE MACHINE MAY BE OPERATED WHILE WAITING FOR REPAIR PARTS FROM THE AUTHORIZED DEALER. SERVICE AND REPAIR, INCLUDING PREVENTIVE MAINTENANCE, ARE THE MAJOR USES OF MOST SERVICE CENTERS.

SECOND, THE SERVICE CENTER PROVIDES THE FACILITIES FOR PERIODIC MAINTENANCE AND OVERHAUL OF EQUIPMENT. IT SERVES TO EFFICIENTLY UTILIZE THE LABOR AVAILABLE. DURING SLACK PERIODS, LABOR CAN BE PRODUCTIVELY UTILIZED THROUGH MAINTAINING AND REPAIRING EQUIPMENT. COMPLETELY SERVICED EQUIPMENT IS MORE LIKELY TO PROVIDE TROUBLE-FREE SERVICE DURING THE CRITICAL DEMAND PERIODS.

THIRD, A WELL EQUIPPED SERVICE CENTER WILL PROVIDE THE FACILITIES TO BUILD OR ALTER EQUIPMENT DESIGN IN ORDER TO MEET THE NEEDS OF THE BUSINESS OPERATION. NEW EQUIPMENT BUILT OR OLD EQUIPMENT UPDATED MAY PROVE LESS COSTLY THAN NEW EQUIPMENT AND PERFORM JUST AS SATISFACTORILY.

THE FARM SERVICE CENTER SHOULD BE CENTRALLY LOCATED TO THE HOME AND OTHER BUILDINGS. IT SHOULD BE LOCATED SO THAT THE BUILDING IS CONVENIENT, MAKING IT EASIER TO UTILIZE YOUR SPARE TIME. ANOTHER REASON FOR LOCATING THE SERVICE CENTER NEAR THE OTHER BUILDINGS IS THE NEED FOR ELECTRICITY AND RUNNING WATER.

SATISFACTORY DRAINAGE OF THE SERVICE CENTER BUILDING SITE IS IMPORTANT. WATER ACCUMULATING AROUND AND IN THE SHOP PROVIDES THE CONDITIONS FOR RUST, DECAY AND ELECTRICAL HAZARDS.

IN ORDER FOR THE SERVICE CENTER TO FIT YOUR NEEDS, CERTAIN EQUIPMENT WILL BE NEEDED. YOU SHOULD DETERMINE WHAT ADDITIONAL TOOLS AND EQUIPMENT YOU WILL REQUIRE. THEN MEASURE THE LENGTH AND WIDTH OF THE LARGEST EQUIPMENT YOU EXPECT TO BUILD OR REPAIR INSIDE THE BUILDING. IF YOU WISH TO HAVE ADDITIONAL SPACE FOR MORE THAN ONE UNIT, FIGURE THE ADDITIONAL SPACE IN THE SAME MANNER. REMEMBER THAT A MINIMUM OF THREE FEET OF PASSAGEWAY IS NEEDED ON ALL SIDES FOR SERVICING MACHINES. ALSO, THE WIDTH AND HEIGHT OF THE LARGEST EQUIPMENT WOULD BE THE MINIMUM WIDTH AND HEIGHT ALLOWABLE FOR THE OVERHEAD DOOR. IT IS RECOMMENDED THAT THE BUILDING BE AT LEAST 32 FEET WIDE AND 44 TO 46 FEET LONG. THIS WILL PROVIDE SPACE TO SERVICE EQUIPMENT AND STORAGE FOR PARTS AND SUPPLIES AROUND THE PERIMETER.

---

[1] CONDENSED FROM *PLANNING A FARM SHOP LAYOUT*. SOUTHERN ASSOCIATION FOR AGRICULTURAL ENGINEERING AND VOCATIONAL AGRICULTURE. ATHENS, GEORGIA.

DOANE'S AGRICULTURAL REPORT PROVIDES THIS RULE OF THUMB: THE SERVICE AREA SHOULD BE TWICE THE AREA OF YOUR LARGEST PIECE OF EQUIPMENT.

THE DEVELOPMENT OF A COMPLETE TOOL AND EQUIPMENT LIST IS ESSENTIAL. USE H-I TO LIST PRESENT TOOLS AND ADDITIONAL EQUIPMENT NEEDED. USE THE TEMPLATES INCLUDED IN THIS UNIT TO DEVELOP THE SERVICE CENTER FLOOR PLAN. HAND TOOLS MAY BE STORED ON A WALL MOUNTED TOOL PANEL OR ON A TOOL DOLLY. ALSO, YOU MAY FIND ADDITIONAL ITEMS YOU MAY WANT TO INCLUDE THAT YOU HAVE NOT PREVIOUSLY LISTED.

A WELL PLANNED SERVICE CENTER WILL PROVIDE A MAXIMUM OF STORAGE SPACE, UTILIZING A MINIMUM AMOUNT OF FLOOR SPACE. CONSIDERATION SHOULD BE GIVEN FOR PROVIDING STORAGE AREAS FOR LUMBER, METAL, MACHINERY PARTS, BOLTS, GARDEN TOOLS, LADDERS, ETC.

THE SIZE OF A SERVICE CENTER BUILDING IS DETERMINED BY THE TOOLS, EQUIPMENT, STORAGE SPACE AND SERVICE AREA REQUIRED BY THE OPERATION. ESTABLISH A TEMPLATE FOR THE SPACE REQUIREMENTS FOR EACH ITEM IN THE SERVICE CENTER. ASSIGN THE SPACE IN THE SERVICE CENTER FOR EACH TEMPLATE. ARRANGE THE TEMPLATES FOR ALL WORK AREAS SURROUNDING THE SERVICE AREA. PLACING THE TEMPLATES BY SECTIONS WILL ESTABLISH THE DIMENSIONS FOR THE SERVICE CENTER. USING TEMPLATES ALLOWS THE INDIVIDUAL TO EXPERIMENT WITH THE LOCATION OF TOOLS, EQUIPMENT AREA AND STORAGE AREA TO DETERMINE THE ARRANGEMENT WHICH BEST FITS THE INDIVIDUAL NEEDS.

DOANE'S AGRICULTURAL REPORT INDICATES THAT THE SIZE OF THE SERVICE ENTRANCE SHOULD PROVIDE EASY PASSAGE OF YOUR WIDEST AND HIGHEST PIECE OF EQUIPMENT. THE SERVICE ENTRANCE DOOR MAY BE 14 TO 16 FEET IN HEIGHT AND 20 FEET WIDE. USUALLY SERVICE DOORS ARE OF THE OVERHEAD OR EXTERNAL SLIDING TYPE.

WHEN DETERMINING THE LOCATION OF YOUR SERVICE AREA, CONSIDER THE FOLLOWING: 1) ENTRANCE AND EXIT, AND 2) WHETHER THE SERVICE AREA IS LOCATED INSIDE OR OUTSIDE. THE SERVICE AREA SHOULD BE ADJACENT TO THE SHOP ENTRANCE. IF YOU PLAN A CONCRETE APRON FOR AN ADDITIONAL SERVICE AREA, PLACE THE ENTRANCE BEHIND THE BUILDING TO CREATE A NEATER APPEARANCE.

THE SERVICE APRON PROVIDES A CONVENIENT LOCATION FOR MINOR REPAIRS, AND OUTSIDE LOCATION FOR FUEL AND WATER FACILITIES.

IT IS IMPORTANT TO LOCATE THE METAL WORKING EQUIPMENT AS CLOSE TO THE SERVICE AREA AS POSSIBLE. IN PLANNING FOR THE METAL WORKING AREA, BEGIN ALONGSIDE THE SERVICE AREA. APPROXIMATELY EIGHT FEET SHOULD BE PROVIDED FOR TOOLS AND WORKBENCHES. THE EQUIPMENT SHOULD CONTINUE ALONG THE SAME AREA. HOWEVER, THE WELDING AREA SHOULD BE LOCATED NEAR THE ENTRANCE TO THE SERVICE AREA SO THAT IT CAN BE USED INSIDE AND OUT FOR VENTILATING PURPOSES.

INDIVIDUALS DESIRING A WOOD WORKING AREA SHOULD LOCATE THE TOOLS AND WORKBENCH ALONG THE SIDE OF THE SERVICE AREA. PROCEED TO LOCATE THE DRILL PRESS, TABLE SAW, JOINTER AND BAND SAW ALONG THE END OF THE SERVICE AREA ALLOWING THE REQUIRED WORK CLEARANCE ON BOTH THE FEED AND DELIVERY

SIDES OF THE EQUIPMENT. LOCATE ALONG THE WALL THE GRINDER, SCRAP CONTAINER AND TOOL CABINET.

ARRANGING MISCELLANEOUS EQUIPMENT IS NOT AS IMPORTANT AS THE LOCATION OF THE METAL AND WOOD WORKING EQUIPMENT. THEREFORE, MISCELLANEOUS EQUIPMENT CAN BE PLANNED TO UTILIZE UNUSED PORTIONS OF THE SERVICE AREA. THE PLACEMENT OF THE AIR COMPRESSOR SHOULD BE NEAR THE SERVICE AREA ENTRANCE. AIR COMPRESSOR OPERATED LUBRICATION EQUIPMENT SHOULD BE LOCATED WITHIN THE AREA WITH THE COMPRESSOR. HAND OPERATED LUBRICATION EQUIPMENT MAY BE MOUNTED ON A PANEL OR DOLLY.

A WATER SUPPLY CONVENIENT FOR FLUSHING RADIATORS, WASHING EQUIPMENT AND FOR FILLING THE WATER VAT USED FOR WELDING IS IMPORTANT. IT IS A GOOD PRACTICE TO PROVIDE RUNNING WATER AND A SINK FOR HAND WASHING AND OTHER SMALL JOBS INVOLVED IN CLEANING WITH WATER. THE SINK AND WATER OUTLETS SHOULD BE LOCATED A MINIMUM OF THREE FEET AWAY FROM MACHINES AND EQUIPMENT THAT WILL RUST.

EVERY SHOP MUST HAVE SOME ARRANGEMENT FOR STORAGE. LUMBER USUALLY REMAINS IN BETTER SHAPE WHEN STORED HORIZONTALLY. HORIZONTAL STORAGE GIVES LESS OPPORTUNITY FOR WARPING AND GETTING OUT OF SHAPE. ALTHOUGH VERTICAL STORAGE REQUIRES LESS AREA AND IS EASIER TO SORT THE LUMBER, YOU MUST LOCATE WHERE YOU CAN TAKE ADVANTAGE OF EXTRA ROOF HEIGHT.

SUCCESSFUL VERTICAL STORAGE REQUIRES THAT LUMBER BE PILED CLOSELY TOGETHER SO IT WILL NOT SAG. A RETAINER AT THE FLOOR LEVEL MUST BE USED TO PREVENT THE LUMBER FROM SLIPPING OUT OF POSITION. METAL MAY BE STORED VERTICALLY TO ENHANCE UTILIZATION OF STORAGE SPACE.

STORAGE FOR NAILS, BOLTS, SCREWS, RIVETS AND STAPLES MAY BE ACCOMPLISHED BY USING GLASS JARS FOR SMALL ITEMS AND METAL CANS FOR LARGER ITEMS. LABEL AND PLACE THESE ON SHELVES ON THE WALL.

NOW THAT YOUR SHOP LAYOUT IS COMPLETE, MAKE SURE YOU HAVE ALLOWED APPROPRIATE CLEARANCES FOR PASSAGE BETWEEN MACHINES. ADDITIONAL ROOM SHOULD BE PROVIDED IN ORDER TO ADD EQUIPMENT WITHOUT MAKING A MAJOR CHANGE IN SHOP EQUIPMENT. THE FINAL SHOP LAYOUT IS COMPLETE AND WILL PERMIT THE FINAL SHOP DIMENSIONS AND THE OUTSIDE WALLS TO BE ENTERED ON THE PLAN. YOU HAVE NOW ESTABLISHED THE TOTAL SPACE REQUIREMENTS FOR THE SERVICE CENTER.

HOWEVER, RENOVATION OF AN EXISTING BUILDING IS USUALLY THE CHEAPEST. CAN THE BUILDING BE RENOVATED ECONOMICALLY TO MEET THE FOLLOWING REQUIREMENTS?

1. PROVIDE AMPLE SPACE
2. DESIRABLE CONSTRUCTION
3. HAVE A SUITABLE FLOOR
4. HAVE A LARGE MAIN ENTRANCE

5. HAVE ADEQUATE LIGHTING AND VENTILATION
6. CONTAIN A SATISFACTORY HEATING SYSTEM

APPENDIX B

INSTRUCTIONAL MATERIALS

HANDOUTS

H-1: OPTIMUM EQUIPMENT LIST

H-2: ARRANGEMENT OF EQUIPMENT TAMPLATES IN RELATION TO SERVICE AREA

H-3: TEMPLATES FOR SHOP EQUIPMENT

TRANSPARENCIES

T-1: THE QUESTION IS - TO BUILD OR NOT TO BUILD?

T-2: PROBABLE REPAIR COST DURING LIFE OF VARIOUS FARM MACHINES

T-3: FACTORS AFFECTING SERVICE CENTER LOCATION

T-4: SIZE OF SERVICE CENTER

T-5: ARRANGEMENT OF EQUIPMENT TO SERVICE AREA

T-6: EQUIPMENT TAMPLATES ARRANGED IN RELATION TO SERVICE AREA

T-7: TEMPLATES FOR SHOP EQUIPMENT

OPTIMUM EQUIPMENT LIST[1]

FARM CARPENTRY

Number	Number Needed	Name of Tool	Description
1		nail hammer	16 oz. curved claw
1		nail hammer	13 oz. curved claw
1		broad hatchet	4½" cut
1		combination square	12" with centering head
1		carpenter's square	body 24", tongue 16" blued, with rafter or framing table
1		steel tape	engineers' 3/8" wide 100' long, black numbers on white background
1		layout tape rule	"powerlock" 12'x1/2" blade, polyester film coated
1		sliding T-bevel	6" metal handle
1		carpenter's level	24" aluminum frame, 6 vials, solid set
1		torpedo level	9" aluminum, 3 vials, plumb level, and 45°
1		chalk line	self chalking, reel type
1		wing dividers	10" pencil attachment
1		jack plane	14" long, 2" cutter
1		block plane	7" long, 1 5/8" cutter at 20° angle, adjustable throat opening
1		cross cut	26", 8 point hollow ground, straight back
1		nest of saws	3 blades-keyhole, compass, plumbers
6		power wood-boring bits	3/8" to 1", brad points
10		drills for wood or metal	high speed, 1/16" to 1/4", with stand

---

[1] Planning and Equipping a Service Center for Your Farm.

Number	Number Needed	Name of Tool	Description
1		set of wood screw pilot bits	to counter sink, and counter bore, automatic stop
1		counter sink	rose, 1/4" shank
4		pocket wood chisels	1/4", 1/2", 3/4", 1"
2		1-bar clamps	5'
8		C-clamps	2" to 3", 2" to 4", 2" to 7", 2" to 10"
5		hand screw drivers	standard blade and tip 3/4", 3", 5", 8", 10"
2		wrecking bars	3/4" x 30" and 5/8" x 18"
1		flat bar	1 3/4" x 13 3/8", forged tool steel beveled, nail slots both ends
1		oil stone	combination, 1" x 2" x 7", coarse and fine
1		grinding wheel dresser	hooded, No. 9, 6 extra cutters
3		nail sets	2/32", 3/32", 4/32"
1		cabinet rasp	10", half round
10		file handles	sizes 1 to 4
1		file brush and card	10"

HOT AND COLD METAL WORKING

Number	Number Needed	Name of Tool	Description
1		anvil	100 or 150 lbs., 1/2 steel face
1		machinist's vise	4 1/2" jaws, stationary base, 60 lbs.
1		machinist's vise	3 1/2" jaws, swivel base
1		heavy duty hammer	2 1/2 lb., cross pein, New England pattern, rim tempered face

Number	Number Needed	Name of Tool	Description
2		ball pein hammers	12 oz. and 20 lz. rim tempered face
1		sledge	6 lb., 32" handle
2		bolt cutters	capacities 1/4" and 1/2"
3		cold chisels	1/2", 5/8", 3/4"
2		center punches	3/8", 1/2"
1		hack saw frame	rigid, adjustable 10" or 12"
1		keyhole hack saw	assorted blades
1		file	10", mill bastard
1		file	12", double cut flat bastard
3		files	6", 8", 10" round bastard
4		triangular taper files	6" regular, 6" slim, 6" extra slim, 4" extra slim taper
1		set of twist drills with stand	high speed, 1/16" to 1/2" by 32nds, straight shank
5		twist drills	1/2" round sure grip shank or tapered depending on drill spindle, sizes 9/16", 5/8", 3/4", 7/8", 1"
1		set combination screw plate tap and die set	taps and dies N.C. and N.F. 8 sizes each from 1/4" to 3/4", one tap, die and collet for each size, two-piece die design. (6 sizes used most are 1/4" to 5/8" N.C.)
1		drill press vise	rapid acting, jaw width 3 1/2", maximum opening 4", length 9 3/8"

FARM MACHINERY AND POWER

Number	Number Needed	Name of Tool	Description
1		set of socket wrenches, 1/4" and 1/2" drives	1/4" set square drive-9 6-point sockets, 3/16" to 1/2" quick release reversible socket and other accessories. 1/2" set square drive-13 12-point sockets, 7/16" to 1 1/8"; 3 12-point deep sockets 3/4", 13/16", 7/8"; 3 8-point sockets 1/2", 9/16", 5/8" and other accessories with steel tool box
9		open-end wrenches	1/4" and 5/16" to 1 1/16" and 1 1/8"
11		box-end wrenches	offset, from 3/8", and 7/16" to 1" and 1 1/16"
3		pin punches	4/32", 6/32", 8/32" points with stock sizes 3/8", 1/2" and 5/8"
3		hand punches	1/8", 3/16", 1/4" points with stock sizes 1/2", 5/8" and 3/4"
2		center punches	1/8" point, 1/2" stock
2		cape chisels	1/4" and 3/8" cutting edges, 1/2" and 5/8" stock
5		flat chisels	3/8", 7/16", 1/2", 5/8", 11/16" cutting edges
14		Allen set-screw wrenches	combination long and short arm 1/16" to 5/16"
2		"vise-grip" wrenches	7" and 10"
1		11-piece tune-up kit	midget pliers, point file, screw driver, screw starter, ignition spark plug and feeler gauges, 6 opne-end ignition wrenches.
4		open-end adjustable wrenches	6", 8", 10", 12"

Number	Number Needed	Name of Tool	Description
1		interlocking slip joint gripping pliers	45° angle, 9" long
3		combination pliers	slip-joint, heavy duty 5", 7", 9"
1		diagonal cutting pliers	6"
1		battery pliers	22° angle, 7" long
1		cotter-key puller	6 1/2" diagonal
1		set of thickness gauges	9 leaves .0015" to .015"
1		battery hydrometer	
5		set-screw drivers	square shank standard tip, blade lengths, 3", 4", 6", 8", 12"
1		set of knock-out wheel pullers	5/8" to 1 1/8"
1		set of screw extractors	straight tapered flutes, sizes 1 to 5 for soft material, and thin wall pipe
1		set of screw extractors	left hand spiral fluted type, sizes 1 to 5

FARM ELECTRICITY

Number	Number Needed	Name of Tool	Description
3		screw drivers	electricians 3", 6", 8"
1		lineman's side-cutting pliers	7"
1		long nose pliers	6"
1		oblique cutting pliers	6"
1		wire gauge	Brown & Sharp No. 688 standar wire gauge for nonferrous metal

Number	Number Needed	Name of Tool	Description
1		wire stripper	wire sizes 10 to 18
1		circuit tester	neon lamp, AC or DC, intensity indicates relative voltage
1		solderless terminal service kit	crimping tool, with bolt slicer and assortment of solderless terminals

SOLDERING AND SHEET METAL

Number	Number Needed	Name of Tool	Description
1		propane torch	(see special tools)
1		electric soldering iron	100 to 300 watts
1		tinner's snips	combination 13", 3" cut
1		aviation type snips	10" straight and combination

PLUMBING

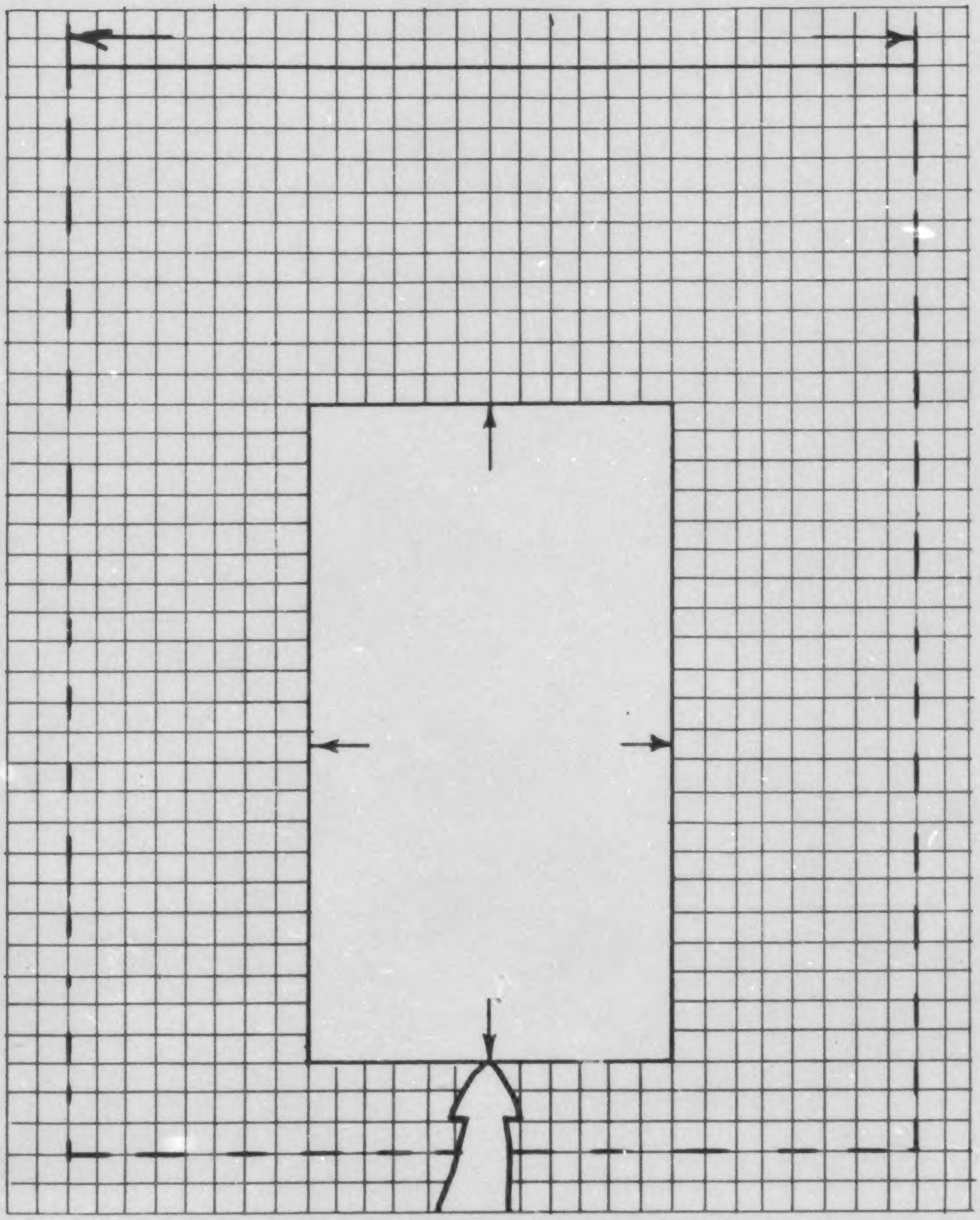
Number	Number Needed	Name of Tool	Description
1		pipe vise capacit	capacity 1/8" to 2"
5		pipe taps	1/8" x 27, 1/4" x 18, 2/8" x 18, 1/2" x 14, 3/4" x 14
6		pipe drop-head ratchet threaders	sizes 1/8" to 1"
1		pipe burring reamer	capacity 1/4" to 2" spiral flutes
3		pipe wrenches	10", 12", 16"
1		flaring tool	9 sizes 1/8" to 3/4" O.D.
1		tube cutter and reamer	3/4" O.D.

SHOP SAFETY AND FIRST AID

Number	Number Needed	Name of Tool	Description
1		first-aid kit	bandages, gauze, "Bandaid," antiseptic, burn dressing, tweezers

Number	Number Needed	Name of Tool	Description
1		pair of goggles	complete eye protection, ventilated side shields
1		face shield	adjustable, 6" x 11" window
1		pressurized chemical fire extinguisher	2 1/2 gallon antifreeze keeps chemical ready to use; for A and B fires
1		dry chemical extinguisher	tank extinguisher, 2 1/2 lb. capacity; for B and C fires

ARRANGEMENT OF EQUIPMENT TEMPLATES IN RELATION TO SERVICE AREA



H-2

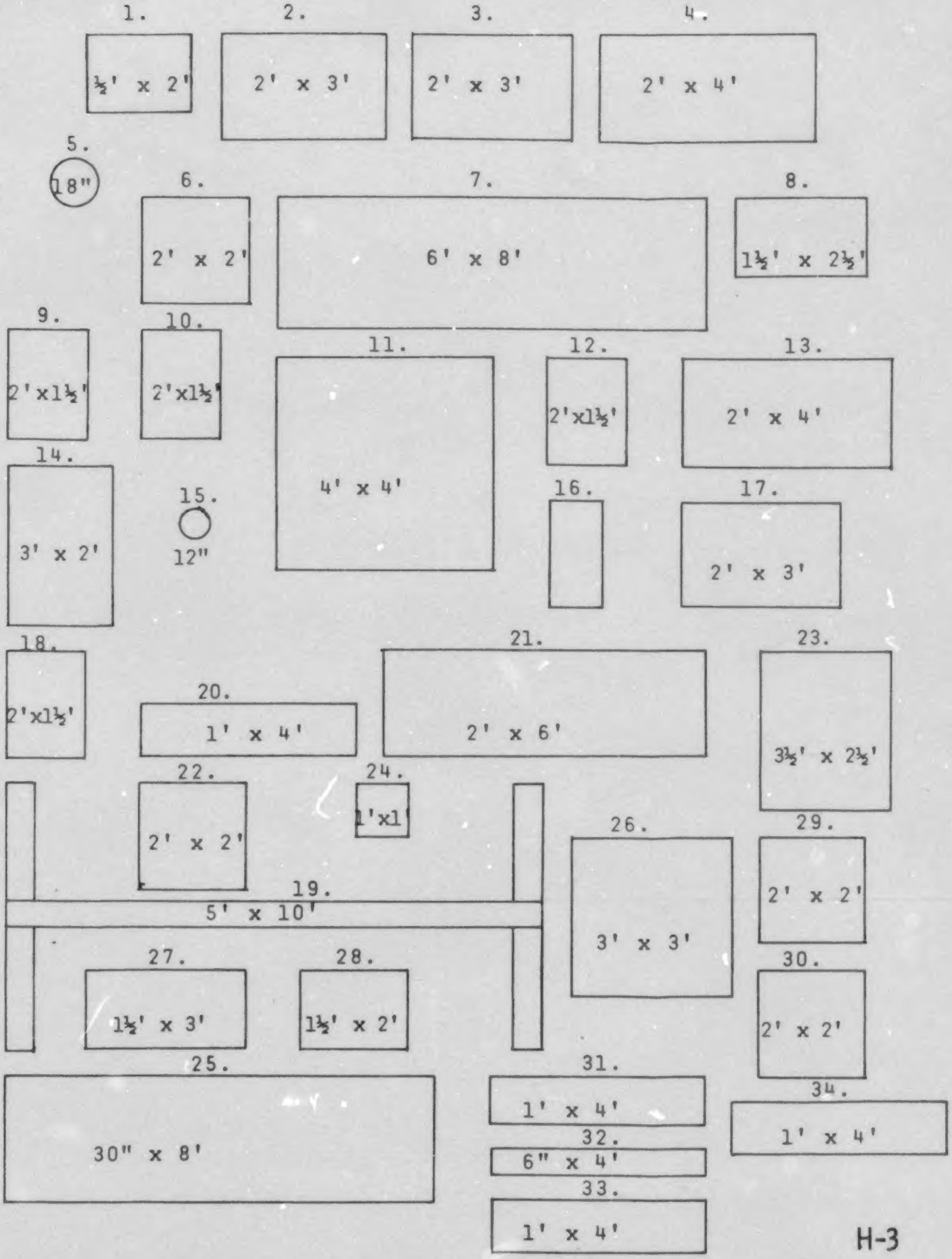
TEMPLATES FOR SHOP EQUIPMENT

1. Portable Electric Welder
2. Oxy-Acetylene Welder
3. Welding Table
4. Portable Forge
5. Water Vat
6. Grinder
7. Metal Working Bench
8. Hack Saw
9. Drill Press
10. Anvil
11. Heater
12. Machine Tool Cabinet
13. Tool Dolly
14. Work Bench
15. Scrap Metal Container
16. Air Compressor
17. Lubrication Container Space
18. Sink
19. Portable A Frame Hoist
20. Masonry Tool Panel
21. Fire Hose
22. File Cabinet
23. Desk
24. Fire Extinguisher
25. Wood Working Bench
26. Table Saw
27. Jointer
28. Band Saw
29. Tool Grinder
30. Scrap Lumber Container
31. Wood Working Tool Panel

32-24. Wall-Mounted Tool Panels

Note: Class Members Cut Out Templates to Arrange Shop Equipment

3/8" = 1'0"


1.
½' x 2'
2.
2' x 3'
3.
2' x 3'
4.
2' x 4'
5.
18"
6.
2' x 2'
7.
6' x 8'
8.
1½' x 2½'
9.
2'x1½'
10.
2'x1½'
11.
4' x 4'
12.
2'x1½'
13.
2' x 4'
14.
3' x 2'
15.
12"
16.
17.
2' x 3'
18.
2'x1½'
20.
1' x 4'
21.
2' x 6'
23.
3½' x 2½'
22.
2' x 2'
24.
1'x1'
19.
5' x 10'
26.
3' x 3'
29.
2' x 2'
27.
1½' x 3'
28.
1½' x 2'
30.
2' x 2'
25.
30" x 8'
31.
1' x 4'
32.
6" x 4'
33.
1' x 4'
34.
1' x 4'

H-3

THE QUESTION IS - TO BUILD OR NOT TO BUILD?[1]

DOES YOUR PRESENT ARRANGEMENT MEET YOUR NEEDS?

HOW MUCH REPAIR AND SERVICE DO YOUR MACHINES AND BUILDINGS NEED?

WOULD A CENTRAL LOCATION OF TOOLS AND PARTS MAKE YOUR OPERATION MORE EFFICIENT?

WOULD A SERVICE CENTER UTILIZE THE LABOR SUPPLY MORE EFFICIENTLY?

CAN YOU AFFORD TO BUILD A FARM SHOP?

---

[1] Shop Planning: Basic Design of Shops and Service Centers, American Association for Vocational Instructional Materials, Athens, Georgia: 1975.

T-1

PROBABLE REPAIR COST DURING LIFE OF VARIOUS FARM MACHINES[1]

Machine	Total Repair Cost in Percent of New Cost
Moldboard Plow	$ 175
Disk Plow	113
Tractor Disk Harrow	163
Spring-Tooth Harrow	120
Grain Drill	96
Corn Planter	84
Field Sprayer	30
Rotary Hoe	20
Tractor Cultivator	150
Manure Loader	25
Manure Spreader	25
Rotary Cutter	35
Tractor Mower	240
Side-Delivery Rake	175
Forage Harvester	58
Forage Blower	50
Pickup Baler	78
Swather	25
Combine, Self-Propelled	54
Corn Picker	64
Feed Grinder	25
Portable Elevator	15
Wagon Gear and Box	90
Tractor	120

---

[1] From Planning a Farm Shop Layout. Southern Association for Agricultural Engineering and Vocational Agriculture. Athens, Georgia.

T-2

FACTORS AFFECTING SERVICE CENTER LOCATION

CONVENIENCE

FIRE HAZARD

DRAINAGE

FUTURE EXPANSION

APPEARANCE

AVAILABILITY OF ELECTRIC SERVICE

AVAILABLE WATER SUPPLY

Planning a Farm Shop Layout. Southern Association for Agricultural Engineering and Vocational Agriculture. Athens, Georgia.

T-3

SIZE OF SERVICE CENTER

- IT IS RECOMMENDED THAT THE BUILDING BE A MINIMUM OF 32 FEET WIDE AND 44 TO 46 FEET LONG.[1]

- RULE OF THUMB: THE SERVICE CENTER SHOULD BE TWICE THE AREA OF YOUR LARGEST PIECE OF EQUIPMENT.[2]

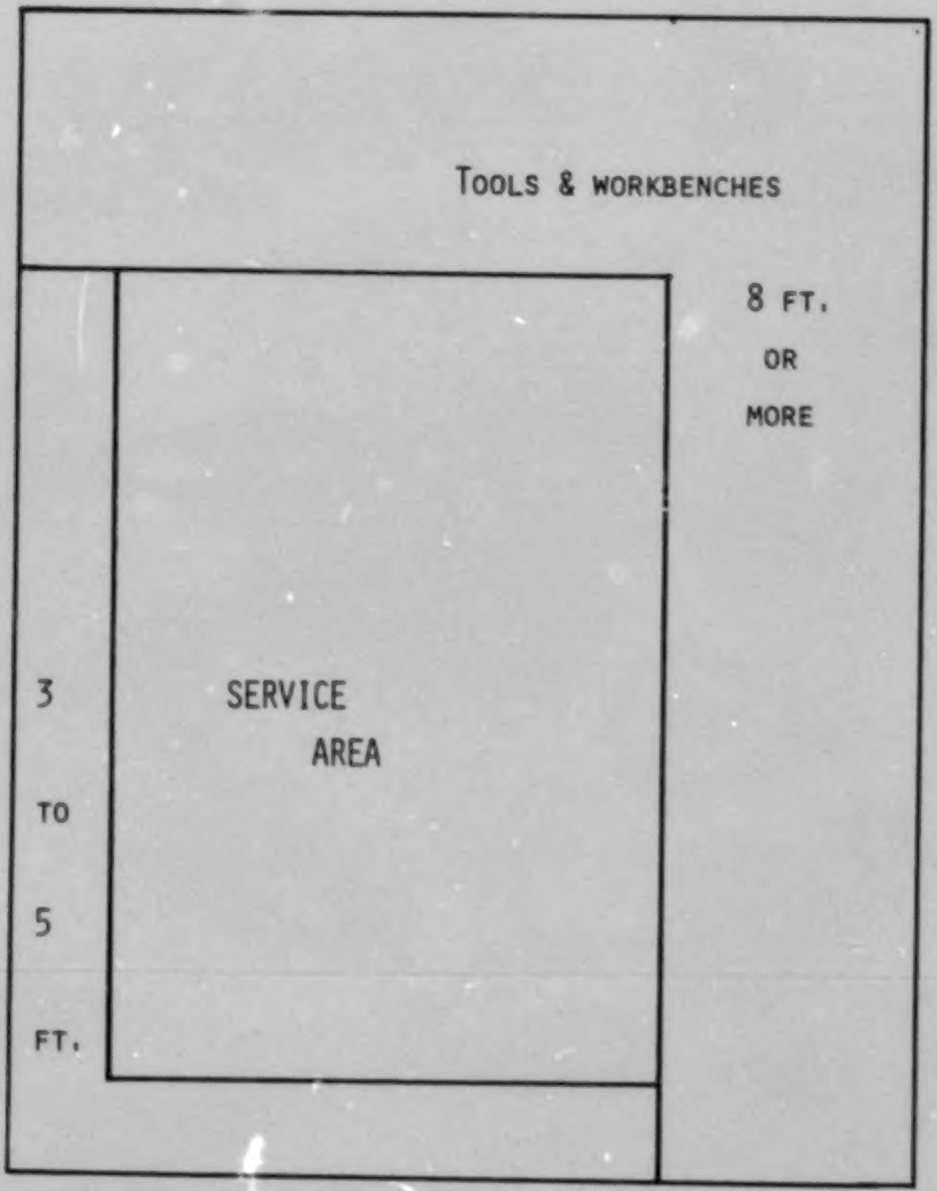
---

[1] Planning a Farm Shop Layout

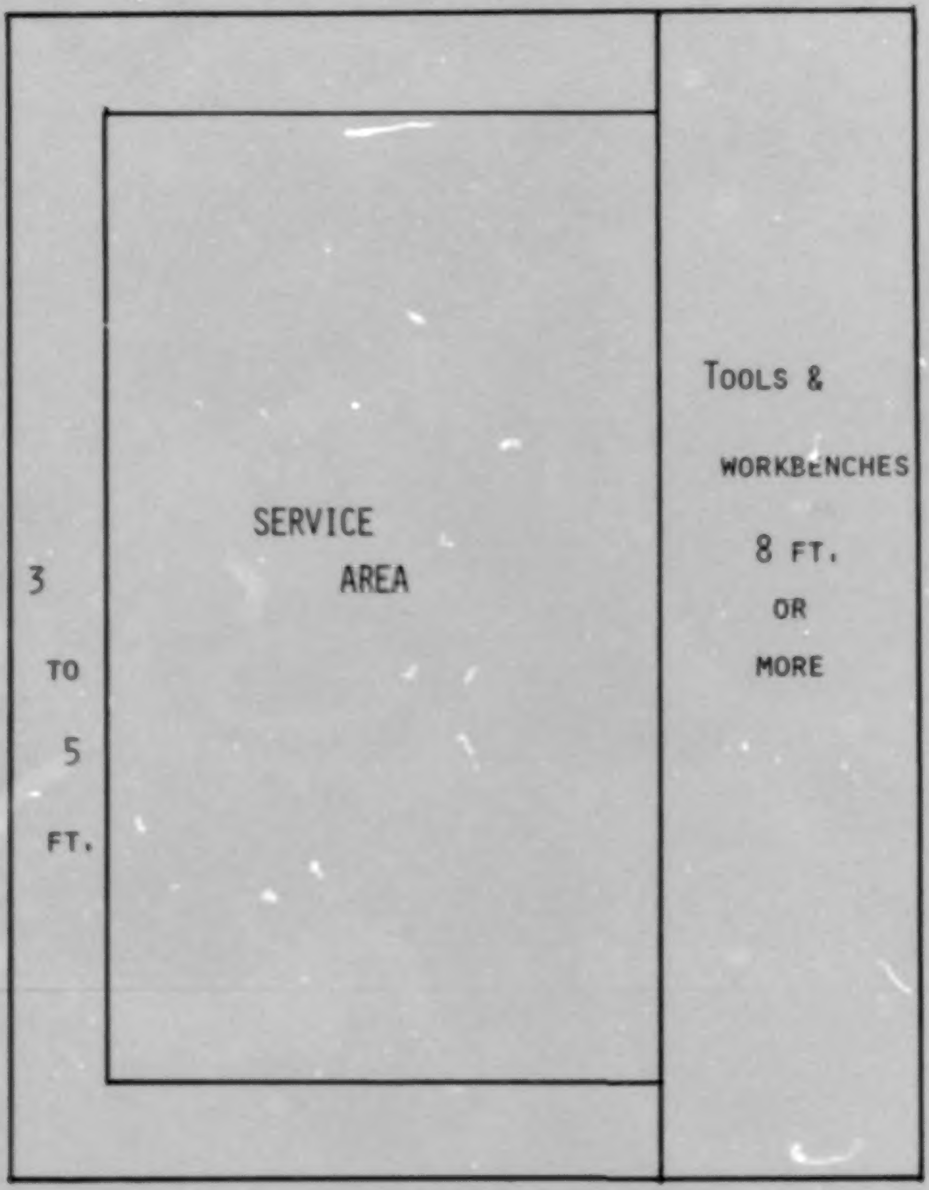
[2] Doane's Agricultural Report

T-4

ARRANGEMENT OF EQUIPMENT TO SERVICE AREA

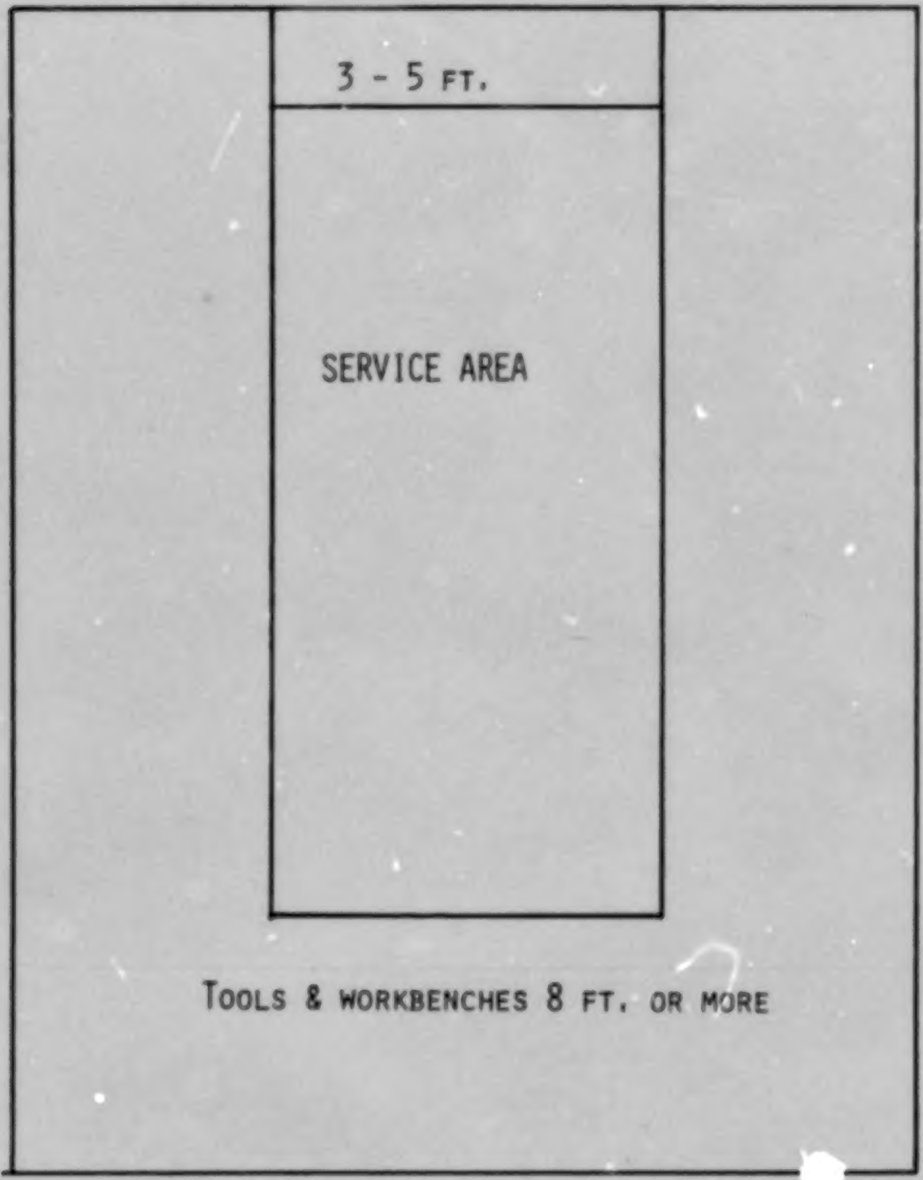

TOOLS & WORKBENCHES
8 FT. OR MORE
SERVICE AREA
3 TO 5 FT.

ARRANGEMENT OF EQUIPMENT TO SERVICE AREA


SERVICE AREA
3 TO 5 FT.
TOOLS & WORKBENCHES
8 FT. OR MORE

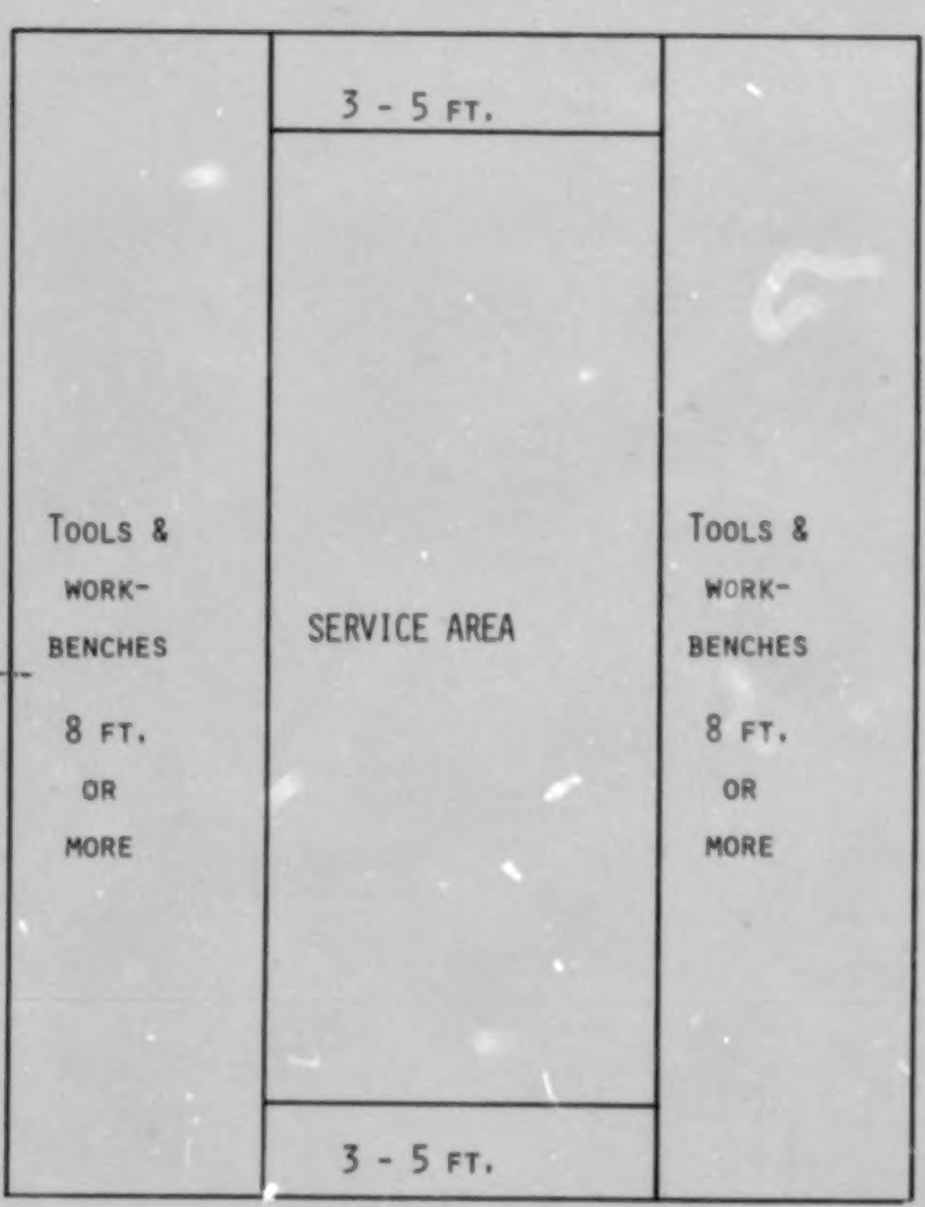
T-5

ARRANGEMENT OF EQUIPMENT TO SERVICE AREA


3 - 5 FT.
SERVICE AREA
TOOLS & WORKBENCHES 8 FT. OR MORE

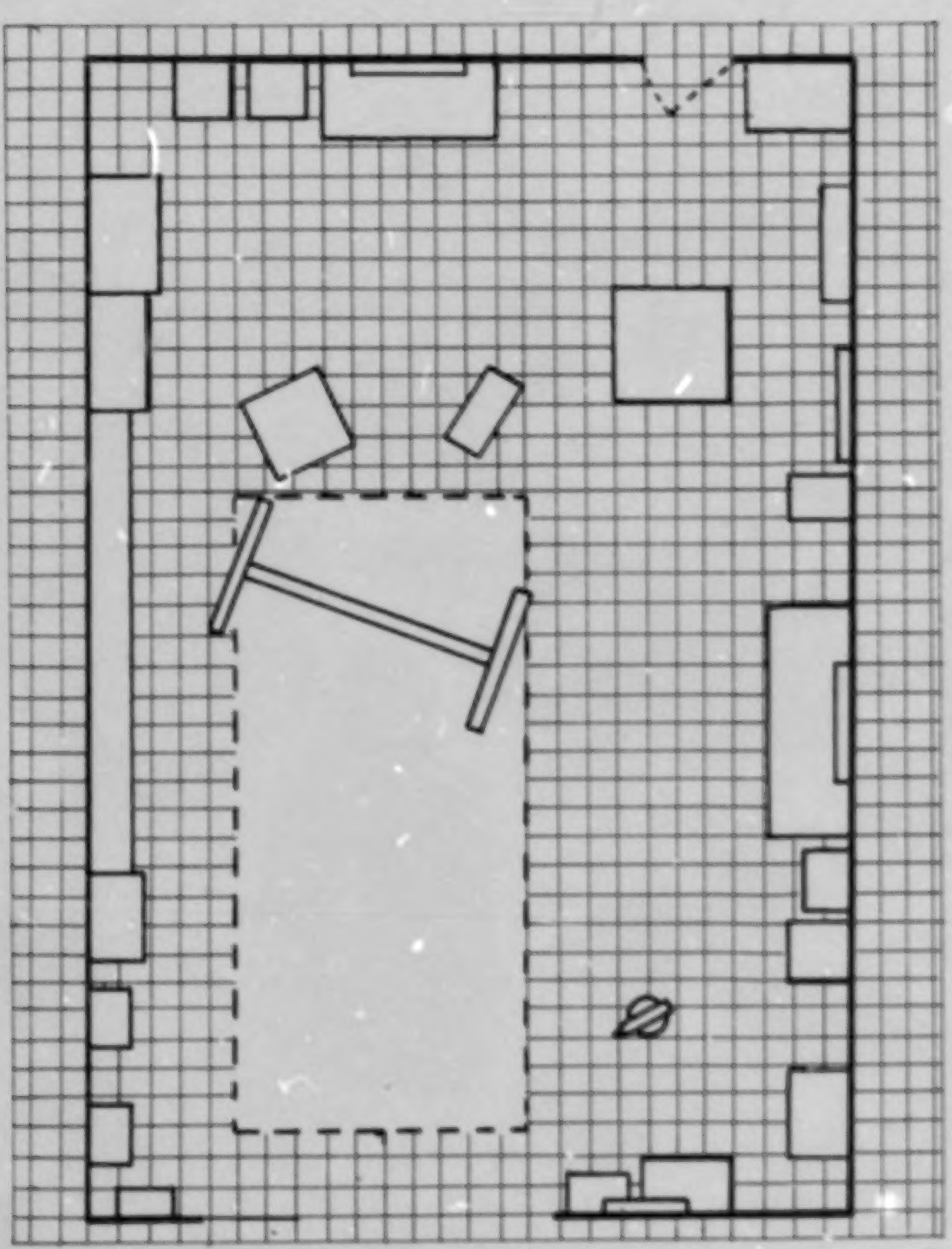
T-5

ARRANGEMENT OF EQUIPMENT TO SERVICE AREA


3 - 5 FT.
TOOLS & WORK-BENCHES 8 FT. OR MORE
SERVICE AREA
TOOLS & WORK-BENCHES 8 FT. OR MORE
3 - 5 FT.

T-5

EQUIPMENT TEMPLATES
ARRANGED IN RELATION TO SERVICE AREA



T-6

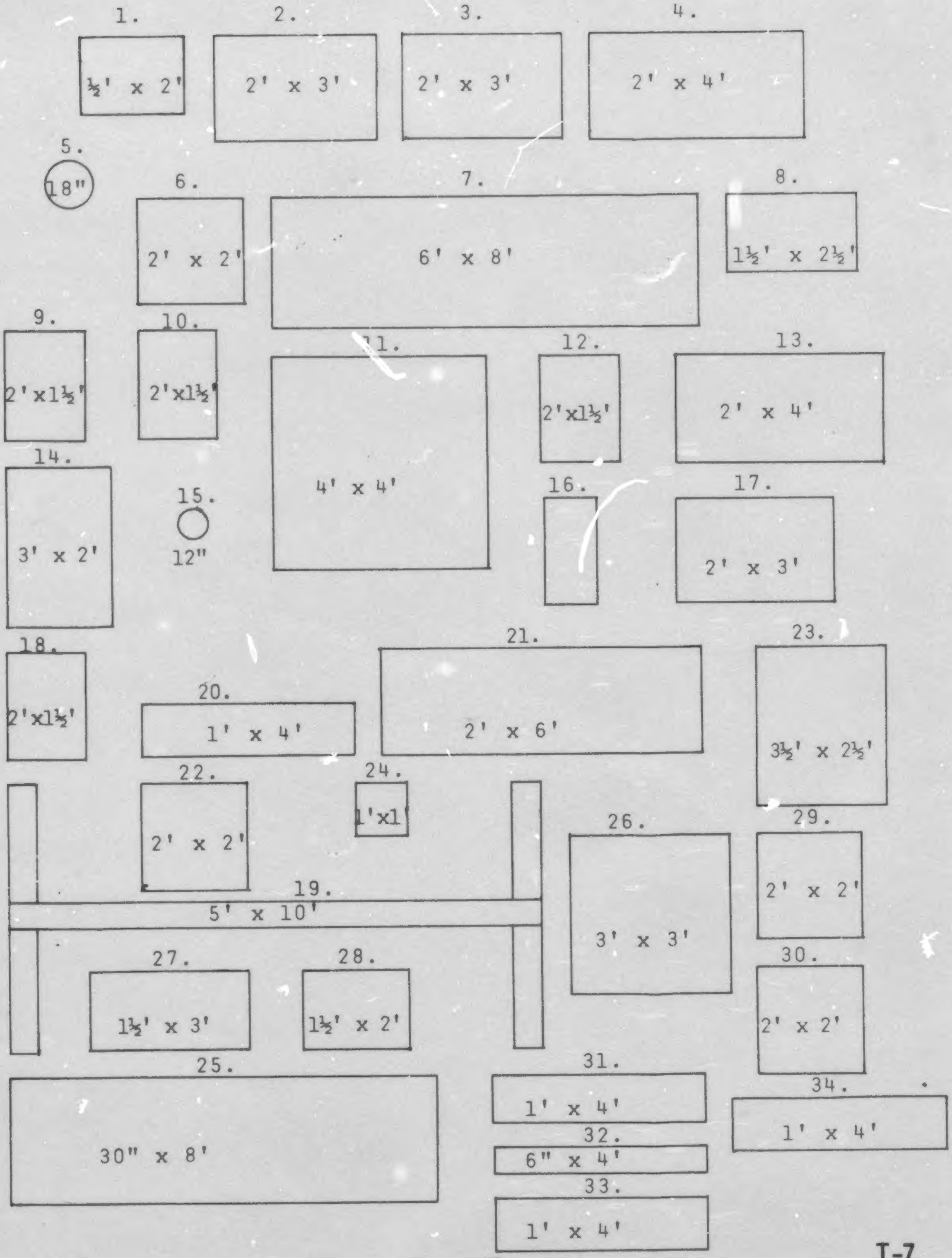
TEMPLATES FOR SHOP EQUIPMENT

1. Portable Electric Welder
2. Oxy-Acetylene Welder
3. Welding Table
4. Portable Forge
5. Water Vat
6. Grinder
7. Metal Working Bench
8. Hack Saw
9. Drill Press
10. Anvil
11. Heater
12. Machine Tool Cabinet
13. Tool Dolly
14. Work Bench
15. Scrap Metal Container
16. Air Compressor
17. Lubrication Container Space
18. Sink
19. Portable A Frame Hoist
20. Masonry Tool Panel
21. Fire Hose
22. File Cabinet
23. Desk
24. Fire Extinguisher
25. Wood Working Bench
26. Table Saw
27. Jointer
28. Band Saw
29. Tool Grinder
30. Scrap Lumber Container
31. Wood Working Tool Panel

32-24. Wall-Mounted Tool Panels

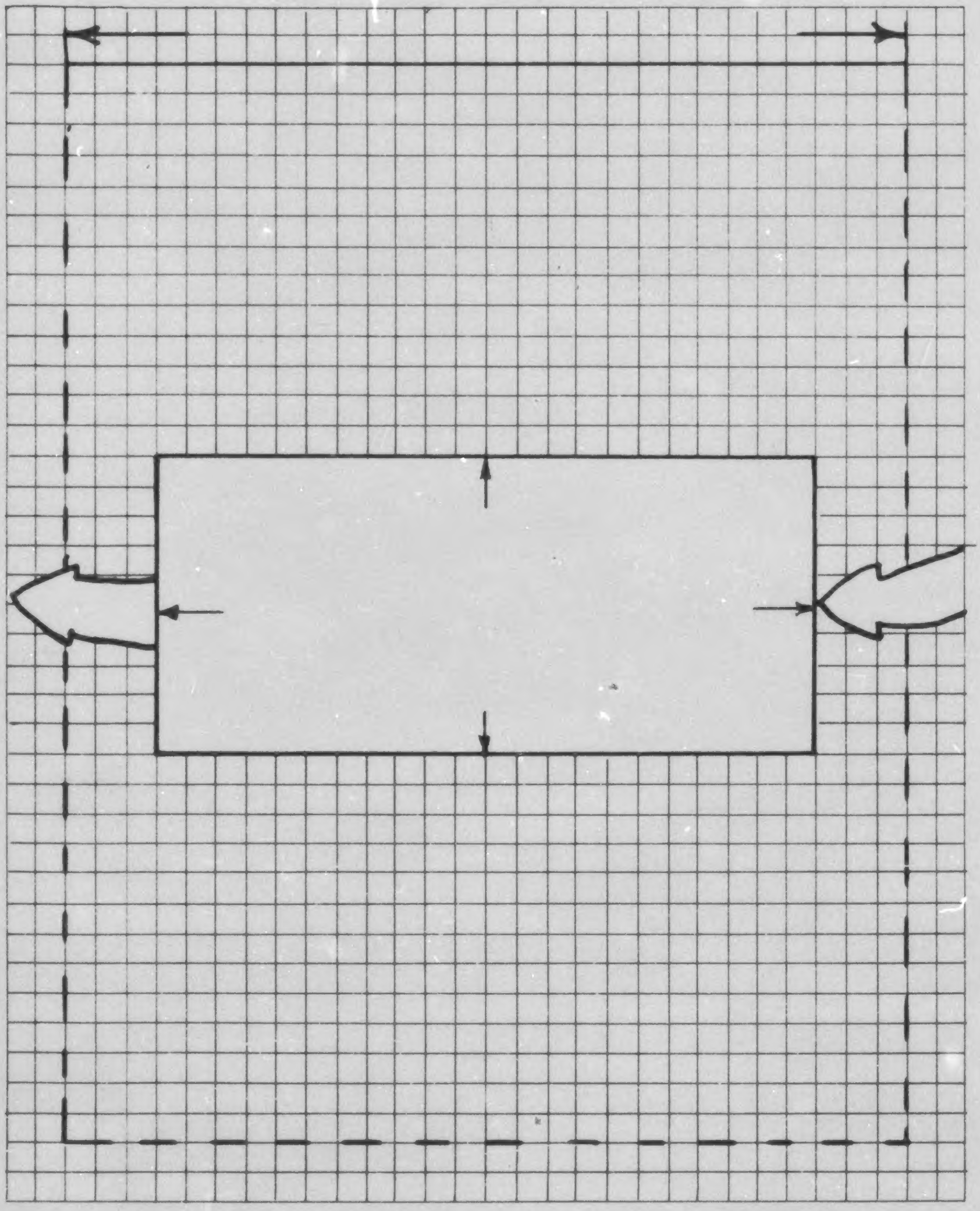
Note: Teachers Cut Out Templates to Illustrate Shop Arrangements

3/8" = 1'0"

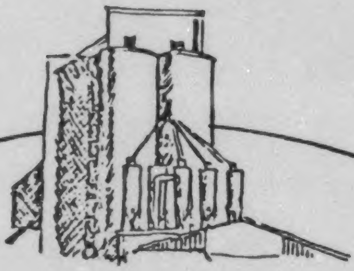

1.
½' x 2'
2.
2' x 3'
3.
2' x 3'
4.
2' x 4'
5.
18"
6.
2' x 2'
7.
6' x 8'
8.
1½' x 2½'
9.
2'x1½'
10.
2'x1½'
11.
4' x 4'
12.
2'x1½'
13.
2' x 4'
14.
3' x 2'
15.
12"
16.
17.
2' x 3'
18.
2'x1½'
20.
1' x 4'
21.
2' x 6'
23.
3½' x 2½'
22.
2' x 2'
24.
1'x1'
19.
5' x 10'
26.
3' x 3'
29.
2' x 2'
27.
1½' x 3'
28.
1½' x 2'
30.
2' x 2'
25.
30" x 8'
31.
1' x 4'
32.
6" x 4'
33.
1' x 4'
34.
1' x 4'

T-7

ARRANGE TEMPLATES OF EQUIPMENT IN RELATION TO SERVICE AREA

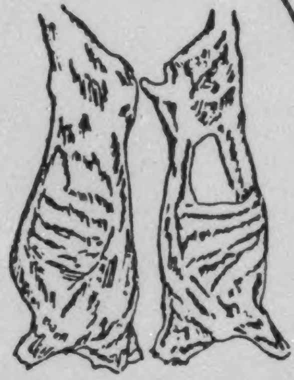


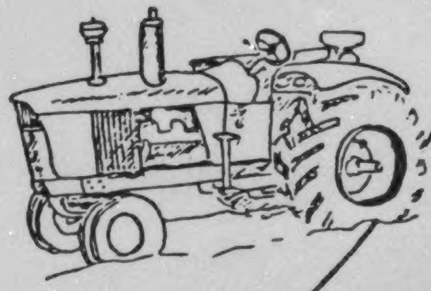
T-7



A BUSINESS
WITHOUT RECORDS
A CLOCK
WITHOUT HANDS

PLANNING A CONFINEMENT HOG FEEDING OPERATION





ADULT UNIT NO. 13

PLANNING A CONFINEMENT HOG FEEDING OPERATION

A RESOURCE UNIT FOR ADULT EDUCATION CLASSES IN AGRICULTURE

DEVELOPED BY
WILBUR FRANTOM

EDITED BY
J. DAVID MCCRACKEN

DEPARTMENT OF AGRICULTURAL EDUCATION
COLLEGE OF AGRICULTURE AND HOME ECONOMICS
THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO 43210

1975

PREFACE

THIS RESOURCE UNIT WAS DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U. S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN
ASSISTANT PROFESSOR

L. H. NEWCOMB
ASSISTANT PROFESSOR

402

TABLE OF CONTENTS

PAGE

PREFACE III

INTRODUCTION 1

STATE SITUATION 3

LOCAL SITUATION 3

OBJECTIVES 3

REFERENCES 4

NEEDED AV EQUIPMENT 4

ALTERNATIVE INTEREST APPROACHES 4

QUESTIONS TO BE ANSWERED 5

LEARNING ACTIVITIES 5

TO SUMMARIZE (NOTE TO TEACHER) 8

APPLICATION 8

APPENDIX A: CONTENT SUMMARY 9

APPENDIX B: INSTRUCTIONAL MATERIALS 16

403

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

404

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATABLE TO THE LOCAL COMMUNITY.

405

PLANNING A CONFINEMENT HOG FEEDING OPERATION

STATE SITUATION

1. BUNDY SAYS THAT OVER 65 PERCENT OF THE FARMS IN THE CORN BELT RAISE HOGS.
2. CONFINEMENT FEEDINGS OF MARKET HOGS SHOULD HAVE A MINIMUM OF 8 SQUARE FEET OF FLOOR SPACE PER HOG.
3. ONE LINEAR FOOT OF FEEDER SPACE IN SELF FEEDER IS REQUIRED PER 5 HEAD.
4. ONE WATERER IS REQUIRED FOR EVERY 20 HEAD.
5. THE CURRENT TREND IS TOWARD CONFINEMENT AND/OR SEMI-CONFINEMENT.
6. FEEDING OF HOGS ON LARGER SCALE IS INCREASING.

LOCAL SITUATION

1. VOCATIONAL AGRICULTURE TEACHERS WHO HAVE BEEN ON THEIR SAME JOB FOR SEVERAL YEARS WILL HAVE NO PROBLEM IN GETTING INFORMATION ON LOCAL SITUATION.
2. RELATED BUSINESS IN LOCAL AREA COULD HELP.
3. THE COUNTY EXTENSION AGENT MAY HAVE NEEDED INFORMATION OR BULLETINS.
4. VISITATION TO SOME OUTSTANDING FARMERS WHO HAVE OR ARE CONSIDERING CONFINEMENT OPERATIONS IN YOUR AREA WOULD PROVE HELPFUL.

OBJECTIVES

THE ADULT SHOULD BE ABLE TO:

1. DESCRIBE THE DIFFERENCE BETWEEN TOTAL CONFINEMENT AND SEMI-CONFINEMENT IN HOG FEEDING OPERATION.
2. SELECT THE PROPER TYPE AND (TOTAL CONFINEMENT VS. SEMI-CONFINEMENT) SIZE BUILDING FOR HIS FARM.
3. CALCULATE THE NECESSARY SPACE REQUIREMENTS FOR EACH METHOD OF HOUSING.
4. RECOGNIZE SYMPTOMS OF STRESS CAUSED BY OVERCROWDING AND ENVIRONMENTAL CONDITIONS IN A CONFINEMENT HOG FEEDING OPERATION.

5. EVALUATE THE VARIOUS TYPES OF WASTE DISPOSAL SYSTEMS.

6. ANALYZE STRUCTURE DESIGNS FOR LABOR SAVING FEATURES.

REFERENCES

BUNDY AND DIGGINS, LIVESTOCK AND POULTRY PRODUCTION, ENGLEWOOD CLIFFS, NEW JERSEY: PRENTICE HALL, INC., 1968.

DOANE, DOANE'S FARM MANAGEMENT GUIDE, 8900 MANCHESTER, ST. LOUIS, MISSOURI. 9TH EDITION. 1971.

ENSMINGER, M. E., THE STOCKMAN'S HANDBOOK, DANVILLE, ILLINOIS: INTERSTATE PRINTERS AND PUBLISHERS.

MWPS - 8, SWINE HANDBOOK HOUSING AND EQUIPMENT, COOPERATIVE EXTENSION SERVICE, DEPARTMENT OF AGRICULTURAL ENGINEERING, COLLEGE OF AGRICULTURE, UNIVERSITY OF ILLINOIS, URBANA, ILLINOIS: MWPS - 8, THIRD EDITION, REVISED 1972.

MUCHLING, A. V., CONFINED FINISHING UNIT, AGRICULTURAL ENGINEERING DEPARTMENT, UNIVERSITY OF ILLINOIS, URBANA, ILLINOIS.

NATIONAL HOG FARMER, 1999 SHEPARD ROAD, SAINT PAUL, MINNESTOA 55116. BULLETIN NO. F-1 TO F-47.

RYAN, DENNIS M., COLD HOG FINISHING HOUSES WITH EITHER SLATS OR BEDDING, AGRICULTURAL EXTENSION SERVICE, UNIVERSITY OF MINNESOTA, REVISED 1971. NO. 4 SERIES.

NEEDED AV EQUIPMENT

OVERHEAD PROJECTOR, MOVIE SCREEN, CHALKBOARD, AND SLIDE PROJECTOR (TO SHOW SLIDE PICTURES OF OPERATIONS WHICH YOU MIGHT TAKE IN YOUR LOCAL AREA).

ALTERNATIVE INTEREST APPROACHES

ALTERNATIVE A. HOLD GROUP DISCUSSION ON PORK PRODUCTION WITH YOUR CLASS.

1. HOW MANY OF YOU HAVE HOGS IN A CONFINEMENT OPERATION? SEMI-CONFINEMENT?

2. HOW MANY OF YOU ARE PLANNING OR THINKING ABOUT GOING TO CONFINEMENT OR SEMI-CONFINEMENT FEEDING PROGRAM IN THE NEAR FUTURE?

ALTERNATIVE B. INTRODUCTION OF TWO GUEST RESOURCE PEOPLE WHO WOULD BE PEOPLE WHO HAVE A CONFINEMENT HOG FEEDING OPERATION IN YOUR LOCAL COMMUNITY.

QUESTIONS WOULD BE REFERRED TO THE RESOURCE PEOPLE AS NEEDED.

ONE RESOURCE PERSON IN TOTAL CONFINEMENT FEEDING AND THE OTHER ONE IN SEMI-CONFINEMENT MIGHT BE USED.

EACH RESOURCE PERSON SHOULD BE GIVEN 10-15 MINUTES AT END OF TEACHER'S LESSON TO EXPLAIN HIS OPERATION.

THE TWO RESOURCE PEOPLE AND TEACHER SHOULD FORM A PANEL TO ANSWER ANY QUESTIONS CLASS MEMBERS MAY HAVE.

QUESTIONS TO BE ANSWERED

1. WHAT IS THE DIFFERENCE BETWEEN CONFINEMENT, SEMI-CONFINEMENT, AND PASTURE HOG FEEDING OPERATION?
2. WHAT ARE THE ADVANTAGES OF CONFINEMENT FEEDING OF HOGS?
3. HOW WOULD BUILDING COSTS COMPARE FOR CONFINEMENT HOG FEEDING VS. SEMI-CONFINEMENT?
4. HOW MUCH FLOOR SPACE WOULD BE NEEDED FOR EACH TYPE HOUSING CONFINEMENT AND SEMI-CONFINEMENT HOG FEEDING PLANS?
5. WHAT ARE SOME OF THE BASIC STANDARDS FOR CONFINEMENT OF FEEDER HOGS? (WATERS-FEEDERS)
6. WHAT ARE SOME OF THE ADVANTAGES OF SLOTTED FLOORS IN CONFINEMENT FEEDING OF HOGS?
7. WHAT ARE THE TRENDS IN SLOTTED FLOORS OR SOLID CONCRETE?
8. WHAT ARE SOME OF THE VENTILATION OPTIONS IN CONFINEMENT FEEDING OF HOGS?
9. HOW DO YOU PLAN AND ARRANGE A BUILDING TO SAVE AS MUCH LABOR AS POSSIBLE?
10. WHAT ARE SOME OF THE PROBLEMS OF TOTAL CONFINEMENT FEEDING OF HOGS?
11. WHAT LOCATION ON THE FARMSTEAD IS BEST SUITED TO A CONFINEMENT HOG FEEDING PROGRAM?
12. WHAT ARE THE PROBLEMS OF MANURE HANDLING OF CONFINEMENT FED HOGS?
13. WHAT ARE THE SYMPTOMS OF HOGS THAT ARE STRESSED?
14. WHAT CAN BE DONE TO OVERCOME STRESS WITH FINISHING HOGS?

LEARNING ACTIVITIES

1. WHAT IS THE DIFFERENCE BETWEEN CONFINEMENT, SEMI-CONFINEMENT, AND PASTURE HOG FEEDING OPERATION?

408

GROUP DISCUSSION ON ALL SITUATIONS.

USE TRANSPARENCIES #1-6 TO ILLUSTRATE TYPES OF CONFINEMENT OPERATIONS.

REFER TO THE CONTENT SUMMARY FOR THE TECHNICAL INFORMATION TO BE DISCUSSED.

2. WHAT ARE THE ADVANTAGES OF CONFINEMENT FEEDING OF HOGS?

GROUP DISCUSSION POINTING OUT SOME ADVANTAGES.

REFER TO HANDOUT #1 MIMEOGRAPHED (PASS IT OUT TO THEM). USE T-7 TO DISCUSS IT WITH THE CLASS.

REFER TO RESOURCE PEOPLE WHERE NEEDED FOR ADDITIONAL INFORMATION.

3. HOW WOULD BUILDING COSTS COMPARE FOR CONFINEMENT HOG FEEDING VS. SEMI-CONFINEMENT?

SHOW TRANSPARENCY #8 AND EXPLAIN IT.

REFER TO RESOURCE PEOPLE ON THEIR SITUATIONS; GET THEIR COST FIGURES IF AVAILABLE.

4. HOW MUCH FLOOR SPACE WOULD BE NEEDED FOR EACH TYPE HOUSING CONFINEMENT AND SEMI-CONFINEMENT HOG FEEDING PLANS?

REFER TO RESOURCE PEOPLE AND THEIR SITUATIONS AS TO SQUARE FEET PER PIG.

SHOW AND EXPLAIN TRANSPARENCY #9 TO ILLUSTRATE BASIC DATA.

5. WHAT ARE SOME OF THE BASIC STANDARDS FOR CONFINEMENT OF FEEDER HOGS? (WATERS-FEEDERS)

USE TRANSPARENCY #9 TO ILLUSTRATE BASIC DATA.

USE HANDOUT #2 TO PROVIDE DATA FOR DISCUSSION.

REFER TO CONTENT SUMMARY FOR TECHNICAL INFORMATION.

6. WHAT ARE SOME OF THE ADVANTAGES OF SLOTTED FLOORS IN CONFINEMENT FEEDING OF HOGS?

REFER TO RESOURCE PEOPLE CONCERNING WHAT THEY ARE USING AND WHY.

USE TRANSPARENCY #10 AND EXPLAIN USING INFORMATION FROM CONTENT SUMMARY.

7. WHAT ARE THE TRENDS IN SLOTTED FLOORS OR SOLID CONCRETE?

USE RESOURCE PEOPLE.

REFER TO CONTENT SUMMARY TO IDENTIFY THE TRENDS.

8. WHAT ARE SOME OF THE VENTILATION OPTIONS IN CONFINEMENT FEEDING OF HOGS?

USE HANDOUT #3 AS REFERENCE.

REFER TO RESOURCE PEOPLE AS NEEDED.

REFER TO CONTENT SUMMARY FOR TECHNICAL INFORMATION.

9. HOW DO YOU PLAN AND ARRANGE A BUILDING TO SAVE AS MUCH LABOR AS POSSIBLE?

USE AND DISCUSS TRANSPARENCIES #1-6, 11, AND 12 TO ILLUSTRATE LABOR REQUIREMENTS.

USE RESOURCE PEOPLE TO DISCUSS LABOR REQUIREMENTS OF THEIR OPERATIONS.

10. WHAT ARE SOME OF THE PROBLEMS OF TOTAL CONFINEMENT FEEDING OF HOGS?

HANDOUT #4 AND TRANSPARENCY #13 PROVIDE INFORMATION FOR DISCUSSION.

REFER TO CONTENT SUMMARY FOR ADDITIONAL INFORMATION.

11. WHAT LOCATION ON THE FARMSTEAD IS BEST SUITED TO A CONFINEMENT HOG FEEDING PROGRAM?

REFER TO CONTENT SUMMARY FOR INFORMATION ON THIS TOPIC.

POINT OUT DRAINAGE AND ODOR PROBLEMS.

12. WHAT ARE THE PROBLEMS OF MANURE HANDLING OF CONFINEMENT FED HOGS?

REFER TO CONTENT SUMMARY FOR TECHNICAL INFORMATION ON HANDLING SYSTEMS.

SHOW TRANSPARENCY #14 TO ILLUSTRATE MAGNITUDE OF THE PROBLEM.

13. WHAT ARE THE SYMPTOMS OF HOGS THAT ARE STRESSED?

GROUP DISCUSSION AND DISCUSSION BY RESOURCE PEOPLE.

REFER TO CONTENT SUMMARY FOR SYMPTOMS.

14. WHAT CAN BE DONE TO OVERCOME STRESS WITH FINISHING HOGS?

GROUP DISCUSSION OF HANDOUT #5 AND TRANSPARENCY #15.

REFER TO CONTENT SUMMARY FOR TECHNICAL INFORMATION.

USE RESOURCE PEOPLE TO DISCUSS METHODS THEY USE.

TO SUMMARIZE (NOTE TO TEACHER

1. MAKE SURE YOU DO NOT GET TOO MUCH INVOLVED IN THE COST FACTOR ON CONFINEMENT FEEDING; YOU COULD GET LOST IN IT. JUST USE AVERAGES AND LOCAL INFORMATION. PRICES ARE CHANGING TOO FAST FOR YOU TO GIVE A SET COST.

2. READ YOUR CONTENT SUMMARY OVER BEFORE YOU TRY TO USE THIS PLAN. ALSO LOOK OVER YOUR INSTRUCTIONAL MATERIAL; YOU MAY WISH TO ADD SOME OR NOT USE SOME THAT IS SUGGESTED.

3. YOUR RESOURCE PEOPLE WILL BE YOUR BEST TEACHING TOOL FOR THIS LESSON PLAN, SO SELECT THEM WISELY. USE THEM AS MUCH AS POSSIBLE, YOU'LL FIND THEM TO BE OF GREAT HELP.

4. READ AND KNOW ALL THE STANDARDS THAT ARE LISTED IN THE INSTRUCTIONAL MATERIAL FOR YOUR USE, AND EXPLAIN THAT THEY ARE JUST GUIDES TO FOLLOW FOR YOUR OWN PROTECTION.

5. TAKE PICTURES (SLIDES) OF RESOURCE PEOPLE'S HOG SET-UPS TO SHOW AT YOUR MEETING, ALSO SLIDES OF OTHER OUTSTANDING CONFINEMENT HOG FINISHING SET-UPS IN YOUR LOCAL AREA.

APPLICATION

A. EVALUATION

   1. DO ON-THE-FARM VISITS AS OFTEN AS NEEDED TO SEE APPLICATIONS OF THINGS TAUGHT.

   2. FILL OUT A SIMPLE EVALUATION SHEET FOR EACH ADULT FARM MEMBER TO CHECK THE THINGS HE HAS ALREADY PUT INTO OPERATION AND THOSE THAT HE ALSO PLANS TO USE LATER.

   3. A FOLLOW-UP STUDY COULD BE DONE LATER (3-5 YEARS) TO SEE HOW MANY ARE BEING USED.

B. APPROVED PRACTICES

   1. TO HAVE A MINIMUM OF 8 SQUARE FEET OF FLOOR SPACE FOR EACH FEEDER PIG IN CONFINEMENT FEEDING.

   2. TO HAVE ONE LINEAR FOOT OF FEEDER SPACE IN SELF-FEEDERS PER EACH 5 HEAD OF FEEDER PIGS.

   3. TO HAVE ONE WATERER FOR EVERY 20 HEAD OF FEEDER PIGS.

   4. TO HAVE A MINIMUM OF 12 SQUARE FEET OF FLOOR SPACE FOR EACH FEEDER PIG IN SEMI-CONFINEMENT FEEDING.

   5. TO CONTROL THE ENVIRONMENTAL SITUATION IN TOTAL CONFINEMENT FEEDER FEEDER PIGS HOUSING WITH DUAL CONTROL FANS.

411

APPENDIX A

CONTENT SUMMARY

1. GENERAL INFORMATION
2. HOUSING
3. FLOORS
4. SLOTTED FLOORS
5. CONCRETE FLOORS
6. COST
7. MANURE HANDLING
8. ENVIRONMENT CONTROL PROBLEMS
9. INSULATION
10. VENTILATION
11. HEAT
12. STRESS

PLANNING A CONFINEMENT HOG FEEDING OPERATION

GENERAL INFORMATION

AN INCREASING NUMBER OF PIGS ARE BEING PRODUCED IN CONFINEMENT EACH YEAR. THE DEVELOPMENT OF COMPLETE AND FORTIFIED RATIONS HAS MADE IT POSSIBLE TO PROVIDE GROWING PIGS WITH THE NUTRIENTS, VITAMINS, AND MINERALS COMMONLY SUPPLIED BY PASTURE FEEDING. VACCINATION AND THE FEEDING OF ARSENICALS AND ANTIBIOTICS HAVE AIDED MATERIALLY IN THE CONTROL OF DISEASE. "PIG PARLOR" PRODUCTION HAS MADE RAPID STRIDES AND SOME PRODUCERS HAVE INVESTED HEAVILY IN HOUSING AND EQUIPMENT. OTHERS, ESPECIALLY IN THE SOUTH, ARE GROWING PIGS IN CONFINEMENT WITH VERY LITTLE INVESTMENT IN HOUSING AND EQUIPMENT.[1]

VERY LITTLE LABOR IS NEEDED WHEN FEEDING WITH THE ENTIRE FLOOR SLOTTED, USING SELF-FEEDERS AND AUTOMATIC WATERERS. SOME ARE USING A COMPLETE PELLETED RATION AND FEEDING DIRECT ON CONCRETE FLOORS. THIS REDUCES WASTE OF FEED, ENCOURAGES THE PIGS TO KEEP THE PEN AREA CLEAN, AND REDUCES THE INVESTMENT IN FEEDING EQUIPMENT. BUT THIS TYPE OF FLOOR FEEDING REQUIRES MORE LABOR AND MANAGEMENT.

SEE REFERENCE NUMBER ONE.

HOUSING

RAISING HOGS IN CONFINEMENT AND SEMI-CONFINEMENT IS BECOMING MORE POPULAR AMONG COMMERCIAL HOG PRODUCERS. THE LARGER PRODUCERS TEND TO USE COMPLETE CONFINEMENT. THE SAVING IN LABOR AND BETTER ENVIRONMENT FOR HOGS AND OPERATORS ARE TWO OF THE MAJOR REASONS. MECHANIZED EQUIPMENT AND SLATTED FLOORS ARE LARGELY RESPONSIBLE FOR THE REDUCTION IN LABOR. THE RESULT IS MORE PRODUCTION WITH THE SAME LABOR, BETTER MANAGEMENT AND FEWER MANUAL TASKS.

A. CONFINEMENT IS A TOTALLY ENCLOSED BUILDING WITH ADEQUATE INSULATION AND PROPER VENTILATION WHICH PROVIDES A BETTER ENVIRONMENT FOR BOTH THE HOG AND THE OPERATOR. THE RESULTS ARE BETTER FEED EFFICIENCY, BETTER DISEASE AND PARASITE CONTROL AND MORE COMFORTABLE OPERATORS.

B. SEMI-CONFINEMENT IS USUALLY AN OPEN FRONT BUILDING, WITH AN OUTSIDE FEEDING AREA. A NEW TYPE OF OPEN-FRONT PARTICALLY SLOTTED FLOOR FINISHING HOUSE HAS BEEN DEVELOPED THAT DIFFERS CONSIDERABLY FROM THE OLD OPEN-FRONT FINISHING BUILDING.

BUILDINGS OPEN ON ONLY ONE SIDE FOR VENTILATION ARE SUGGESTED. FOR SATISFACTORY VENTILATION IT IS SUGGESTED THAT THEY BE OPEN TO THE SOUTH. MOST FINISHING HOUSES IN THE NORTHERN STATES ARE INSULATED BUILDINGS WITH BUILT-IN VENTILATION AND SANITATION CONTROLS.

---

[1] BUNDY AND DIGGINS, LIVESTOCK AND POULTRY PRODUCTION, ENGLEWOOD CLIFFS, NEW JERSEY: PRENTICE HALL, INC., 1968.

413

Floors

Considerable labor and feed are saved in feeding and in managing hogs on concrete floors.

More of the fertilizer value of the manure is saved, and more sanitary conditions can be maintained by using concrete or paved feeding floors. A good feeding floor is a must in confinement feeding, especially during the wet weather.[2]

Slotted Floors

Controlled floor feeding has done a great deal to promote partially slotted-floor buildings. Self-feeders as a part of most new construction. Floors have never stayed as clean in the partially slotted-floor buildings as in totally slotted buildings. Keeping partially slotted floors clean is almost a continuous job. Totally slotted floors are always clean if the pen is full of pigs.

Concrete Floors

The cost of slotted floors may be prohibitive for some producers. A paved or concrete feeding floor may be the answer to sanitation problem of confinement feeding. Concrete feeding floors can be cleaned quite easily, and the pigs do not have to use their energy in wading through mud during the wet fall and spring seasons.

Cost

Confinement feeding may be more economical on very high priced land and when large numbers of hogs are produced on small farms. Rations for pigs fed in confinement must be more highly fortified than pasture feeding, which means feed cost will be higher.[3]

As confinement buildings for hogs are becoming specialized and require sound engineering to assure successful operation. It is not unusual for an operator to invest from $30,000.00 to $75,000.00 in a confinement system. Sound engineering practices must be followed if these investments are to pay off.

A chart from Dennis M. Ryan, Cold Hog Finishing Houses with Either Slats or Bedding. Series No. 4 Bulletin revised in 1971 gave the following original building cost per square feet in an 840 capacity building.

---

[2] Ibid.

[3] Ibid.

1. SOLID FLOORS, WITH DUNGING ALLEY, 2,400 SQUARE FOOT BUILDING NEEDED TO HANDLE 840 HEAD, COST $2.50 PER SQ. FOOT.

2. COLD SLOTTED FLOORS WITH PIT, 2,400 SQ. FEET BUILDING NEEDED TO HANDLE 840 HEAD, COST $3.75 PER SQ. FOOT.

3. WARM ALL SLOTTED FLOORS WITH PIT, 1,680 SQUARE FEET BUILDING NEEDED TO HANDLE 840 HEAD, COST $7.00 PER SQ. FOOT.

YOU MUST REMEMBER COST HAVE GONE UP CONSIDERABLY. WHEN TEACHING, DO NOT TRY TO FIGURE TODAY'S COST BY THE ABOVE FIGURES, GIVE ONLY TOTAL COST GUIDES OBTAINED FROM PEOPLE WHO ARE IN A POSITION TO KNOW. USE LOCAL COSTS IF AT ALL POSSIBLE.

MANURE HANDLING

A MAJOR PROBLEM OF COMMERCIAL HOG FARMERS IS HANDLING AND DISPOSING OF MANURE AND CONTROLLING UNDESIRABLE ODORS. AS HOG FARMERS GET LARGER, THE WASTE PROBLEMS INCREASE AND ATTRACT MORE PUBLIC ATTENTION. IT IS ONLY A MATTER OF TIME UNTIL LEGISTLATION WILL REQUIRE EVERY COMMERCIAL PRODUCTION UNIT TO HAVE A TREATMENT PLANT OR AN APPROVED METHOD OF HANDLING HOG WASTE.

MOST LAGOONS ARE TOO SMALL TO SATISFACTORILY TREAT ALL OF THE MANURE FROM A PRODUCTION UNIT.[4] THE MOST COMMON METHOD OF HANDLING MANURE HAS BEEN TO HAUL IT DIRECT TO THE FIELD AND USE A PIT OR A PIT-LAGOON COMBINATION. WHEN THE FARMER IS BUSY IN THE FIELD OR THE WEATHER WILL NOT PERMIT HAULING, HE LETS THE STORAGE PITS FILL UP. THE LIQUID WASTE RUNS OUT OF THE OVERFLOW TO THE LAGOON, AND THE SOLIDS REMAIN IN THE PIT TO BE HAULED AWAY LATER. SEVERAL NEW TREATING METHODS ARE BEING STUDIED, OF WHICH THE OXIDATION METHOD SHOWS THE MOST PROMISE.

MANURE LOAD IN A HOG FINISHING UNIT IS CONSIDERABLY HEAVIER THAN IN A FARROWING OR NURSERY UNIT. THEREFORE, MORE RESEARCH IS NEEDED BEFORE DEFINITE RECOMMENDATIONS CAN BE MADE ABOUT THE USE OF OXIDATION DITCHES FOR TREATING OF HOG WASTES. THE PRINCIPAL PARTS OF THE OXIDATION DITCH ARE A CONTINUOUS OPEN CHANNEL SHAPED LIKE A RACE TRACK, WHICH HOLDS THE HOG WASTES, AND AN AERATION ROTOR TO SUPPLY THE NECESSARY OXYGEN AND CIRCULATE WASTES.[5]

CONTROLLING UNDESIRABLE ODORS IS A MAJOR PROBLEM IN CONFINEMENT HOG HOUSING. SEVERAL DIFFERENT TREATMENTS HAVE BEEN TRIED IN A CONTINUING EFFORT TO FIND THE BEST WAY OF DEODORIZING HOG MANURE. MIXING HYDRATED LIME WITH THE LIQUID MANURE IS ONE TREATMENT THAT IS BOTH EFFECTIVE AND ECONOMICAL. THE HYDRATED LIME, DILUTED WITH WATER, SHOULD BE

---

[4] RYAN, DENNIS M., COLD HOG FINISHING HOUSES WITH EITHER SLATS OR BEDDING. AGRICULTURAL EXTENSION SERVICE, UNIVERSITY OF MINNESOTA; REVISED 1971. NO. 4 SERIES.

[5] IBID.

ADDED. THIS LIME TREATMENT WILL COST ABOUT 62 CENTS PER HOG FOR A SIX MONTH PERIOD WHEN APPLIED AT THE RECOMMENDED RATE OF 0.16 POUNDS PER 100 POUNDS HOG PER DAY.[6]

HAULING MANURE DIRECT TO THE FIELD WHEN TIME AND WEATHER PERMITS IS BEST. THE VACUUM TANK WAGON HAS MADE HAULING EASIER, AND IT SEEMS TO BE THE MOST POPULAR SYSTEM TODAY.

ENVIRONMENT CONTROL PROBLEMS

SUCCESSFUL CONFINEMENT BUILDINGS MUST HAVE A CONTROLLED ENVIRONMENT. VENTILATION, INSULATION, HEATING, AND COOLING, AND MOISTURE CONTROL ARE MORE CRITICAL IN A HIGHLY POPULATED, TOTALLY ENCLOSED BUILDING THAN IN OLDER OPEN BUILDINGS.

INSULATION

INSULATION IS USED FOR THREE REASONS:

1. TO REDUCE HEAT GAINS DURING SUMMER.
2. TO REDUCE HEAT LOSSES DURING THE WINTER.
3. TO CONTROL CONDENSATION.

WITH ENOUGH INSULATION TO REDUCE HEAT LOSSES, ANIMAL BODY HEAT MAINTAINS A SATISFACTORY WINTER TEMPERATURE.[7]

PROVIDE A MINIMUM OF 2 INCHES IN THE WALLS AND 3 INCHES IN THE CEILING FOR INSULATION. INSTALL THE INSULATION WITH AN ADEQUATE VAPOR BARRIER TO PROTECT IT FROM MOISTURE PRODUCED BY THE HOGS.[8]

VENTILATION

ADEQUATE VENTILATION IN BOTH WINTER AND SUMMER IS ABSOLUTELY NECESSARY FOR SUCCESSFUL HOG CONFINEMENT. IT IS ALMOST IMPOSSIBLE TO PROVIDE BOTH WINTER AND SUMMER VENTILATION WITH ONE SYSTEM; SEPARATE SYSTEMS ARE NECESSARY.[9] IT IS IMPORTANT THAT BOTH INTAKE AND EXHAUST FANS BE USED IN ORDER TO MAINTAIN A UNIFORM TEMPERATURE OF 68 TO 70 DEGREES IN CONFINEMENT BUILDING FEEDING.

---

[6] IBID.

[7] DOANE, DOANE'S FARM MANAGEMENT GUIDE, 8900 MANCHESTER, ST. LOUIS, MISSOURI. 9TH EDITION, 1971.

[8] RYAN, DENNIS M., IBID.

[9] IBID.

416

SUMMER VENTILATION REQUIRES ABOUT 10 TIMES AS MUCH AIR MOVEMENT AS WINTER VENTILATION. MORE FAN POWER WILL BE REQUIRED IF ALL OF THE ADDITIONAL AIR IS MOVED MECHANICALLY. NATURAL VENTILATION, SUCH AS DOORS WHICH OPEN ON BOTH SIDES OF THE HOUSE CAN ALSO BE USED. NORMALLY, MOVING ENOUGH AIR DURING HOT WEATHER WILL REMOVE THE MOISTURE.

A CONFINEMENT HOG PRODUCTION SET-UP WITH A WATER SPRINKLING SYSTEM FOR COOLING HOGS ON A HOT DAY COULD BE USED IF YOU HAVE A PROPER FLOOR. A DRAINAGE SYSTEM IS A MUST.

THE MOISTURE MUST BE REMOVED THROUGH THE VENTILATION SYSTEM. A SYSTEM USING RATED FANS INSTALLED ACCORDING TO MANUFACTURER'S INSTRUCTIONS IS BEST. MAIN PURPOSES OF WINTER VENTILATION TO REMOVE WATER VAPORS BEFORE THEY CONDENSE ON COLD SURFACES AND TO EVAPORATE SPILLED WATER AND URINE. A DRY BUILDING, PARTICULARLY A DRY FLOOR, IS NECESSARY TO MAINTAIN THE HEALTH OF SMALL FEEDER PIGS.

HEAT

SPACE HEATERS MAY DO WELL FOR THE REQUIRED SUPPLEMENTAL HEAT. ALL GAS HEATERS SHOULD BE VENTED TO THE OUTSIDE.

ADEQUATE SPACE HEAT IS PARTICULARLY ESSENTIAL IN SLOTTED FLOOR HOUSES. A HIGHER ROOM TEMPERATURE MUST BE MAINTAINED SINCE DRAFTS ARE MORE TROUBLESOME ON SLATS THAN ON CONVENTIONAL FLOORS.[10]

IF A BUILDING IS WELL INSULATED AND VENTILATED, NO HEAT SYSTEM IS NECESSARY FOR FINISHING HOGS ON SOLID FLOORS.

STRESS

SOME PIGS ARE UNABLE TO WITHSTAND THE STRESS OF MANAGEMENT PROCEDURES THAT INVOLVE HANDLING AND CROWDING, TRANSPORTATION, OR SUDDEN ENVIRONMENTAL CHANGES. WHEN THESE PIGS ARE SUBJECTED TO SUCH SITUATIONS, THEY SHOW A REACTION THAT MAY RESULT IN DEATH.

STRESS-SUSCEPTIBLE ANIMALS SEEM TO BE EASILY FRIGHTENED AND DIFFICULT TO MANAGE. TRANSPORTATION OR MOVEMENT TO A NEW ENVIRONMENT ARE PARTICULARLY STRONG STIMULI FOR SUCH ANIMALS.

CERTAIN TYPES OF CONFINEMENT SEEM TO BE ASSOCIATED WITH PROBLEMS OF LEG WEAKNESS, GASTRIC ULCERS AND POOR RESISTANCE TO DISEASE. ONE OF THE CONSISTENT TRAITS OF PIGS WITH STRESS IS TAIL TREMOR AND POSSIBLY TAIL BITING. BODY TEMPERATURE INCREASES TO AS HIGH AS 110 DEGREES BUT IN SUCH CASES, DEATH USUALLY RESULTS. ANIMALS MAY GO OFF FEED AND WILL NOT MAKE THE NECESSARY GAIN FOR GOOD PROFIT.

---

[10] DOANE, IBID.

417

THE FOLLOWING ARE SOME SUGGESTIONS FOR REDUCING LOSSES FROM STRESS:

1. ELIMINATE, MINIMIZE OR REDUCE ALL TYPES OF STRESS.

    A. AVOID CROWDING; CROWDING CONDITIONS ON THE FARM, OR DURING TRANSPORTATION UPSET HOGS AND SHOULD BE AVOIDED. PRODUCERS SHOULD FOLLOW SUGGESTED SPACE REQUIREMENTS DURING ALL STAGES OF PRODUCTION.

    B. DON'T MIX HOGS. PIGS HAVE A SOCIAL ORDER AND MIXING PIGS DISTURBS THIS ORDER AND LEADS TO FRICTION--THUS STRESS, FIGHTING AND PIG DEATH LOSSES.

    C. TREAT PIGS QUIETLY AT ALL TIMES. WHEN HANDLING PIGS FOR ANY REASON DO IT WITH A MINIMUM OF DISTURBANCE. PIG STRESS INCREASES DURING MOVING AND MARKETING.

    D. AVOID SUDDEN TEMPERATURE OR ENVIRONMENTAL CHANGES. KEEP PIGS COOL. DO NOT MOVE PIGS DURING HIGH ENVIRONMENTAL TEMPERATURES.

2. OTHER MANAGEMENT CAUTIONS AND SUGGESTIONS:

    A. DO NOT USE OR ALLOW THE USE OF AN ELECTRIC PROD DURING PIG LOADING OR UNLOADING FOR MARKETING.

    B. DO NOT FEED PIGS 12-24 HOURS PRIOR TO MARKETING.

    C. TRY TO MOVE PIGS IN THE "COOL OF THE DAY."

    D. WHENEVER POSSIBLE, SPREAD STRESS OVER LONG TIME PERIODS.

    E. ENCOURAGE PREMIUM TO TRUCKERS DELIVERING LIVE HEALTHY PIGS.

418

APPENDIX B

INSTRUCTIONAL MATERIALS

HANDOUTS

H-1: ADVANTAGES OF CONFINEMENT FEEDING OF HOGS

H-2: SPACE REQUIREMENTS OF BUILDING AND EQUIPMENT FOR SERVICE

H-3: HOG HOUSE VENTILATION

H-4: PROBLEMS OF TOTAL CONFINEMENT

H-5: REDUCING LOSSES FROM STRESS

TRANSPARENCIES

T-1: BUILDING SIZE

T-2: FULL SLOTTED FLOOR

T-3: ONE CENTER PIT

T-4: TWO SIDE PITS

T-5: OPEN FRONT

T-6: OPEN FRONT - OUTDOOR LOT

T-7: ADVANTAGES OF CONFINEMENT FEEDING OF HOGS

T-8: ORIGINAL COST

T-9: SPACE REQUIREMENTS FOR LIVESTOCK

T-10: ADVANTAGES OF SLOTTED FLOOR

T-11: SLOTTED FLOOR WITH TWO SIDE ALLEYS

T-12: RECOMMENDED MINIMUM WIDTH FOR SERVICE PASSAGES

T-13: PROBLEMS OF TOTAL CONFINEMENT OF FINISHING SWINE

T-14: APPROXIMATE DAILY MANURE PRODUCTION

T-15: REDUCING LOSSES FROM STRESS

CHART 1

ADVANTAGES OF CONFINEMENT FEEDING OF HOGS

1. It may not be economical to use land with high value ($600 to $1,000) per acre.
2. More rapid gains can be produced when pigs are in confinement if adequate ration and good management are provided.
3. Confinement facilities can be used during more months of the year than can pasture facilities.
4. There is less labor required when pigs are in confinement feeding.
5. Less labor and difficulty in providing an adequate supply of feed and water is another advantage.
6. Fence problems will be minor compared to pasture feeding.
7. The confinement method is best for growing or feeding out large numbers of hogs on small farms.

By Bundy and Diggins: Livestock and Poultry Production

SPACE REQUIREMENTS OF BUILDING AND EQUIPMENT FOR SWINE

	SWINE BUILDINGS						FEEDING & WATERING EQUIPMENT		
Age and Size of Animal	Floor Area Per Animal (Sq. Ft.)	Height of Ceiling (Ft.)	Height of Pen Parition (In.)	Window Space Central Hog House (Sq. Ft.)	Hog Door Height	Hog Door Width	Grain Self-feeder Space Per Animal (Linear Ft.)	Water Per Head Per Day (Gal.)	Watering Cups if Used
Pigs Weaning to 100 Pounds	6 - 8	7 - 8	32	1 sq. ft. to 30-40 sq. ft. floor space	36"	24"	1 ft./5 to 6 Head	½ - 1½	1 Cup per 20 Head
Growing Fattening Hogs 100 - 225 Pounds	8 - 12	7 - 8	36	1 sq. ft. to 30-40 sq. ft. floor space	36"	24"	1 ft./4 to 5 Head	1½ - 3	1 Cup per 20 Head

The Stockman's Handbook, Table 73, Page 345.

1. Over and above the sleeping space given herein, pigs that are confined from weaning to market should be provided the following feeding floor space: (1) 15 sq. ft. if fed from troughs, and (2) 10 sq. ft. if fed from self-feeders.

2. Ceiling heights in excess of 7 to 8 ft. makes for cold hog houses in northern half of the United States.

3. Where automatic watering cups are used, provide one cup for each 20 pigs. (An automatic waterer with two openings should be considered two cups.)

4. Use the lower limits for hogs on pasture and upper limits for hogs in dry lot or confinement.

HOG HOUSE VENTILATION

1. To remove the moisture produced in the building.
2. To provide as favorable an environment as possible.
   A. Increase the rate of growth
   B. Improves feed efficiency
3. To remove odors.
4. To provide oxygen for the animals' needs.
5. To remove impurities or possible disease-bearing organisms.

OTHERS

1. Sufficient quantity of air.
2. Complete distribution of the air.
3. Proper condition of the air.

PROBLEMS OF TOTAL CONFINEMENT
OF FINISHING SWINE

1. Over crowding
2. Proper ventilation
3. Odors and control
4. Manure handling
5. Hog stress
6. Cost of confinement building and equipment
7. Heating

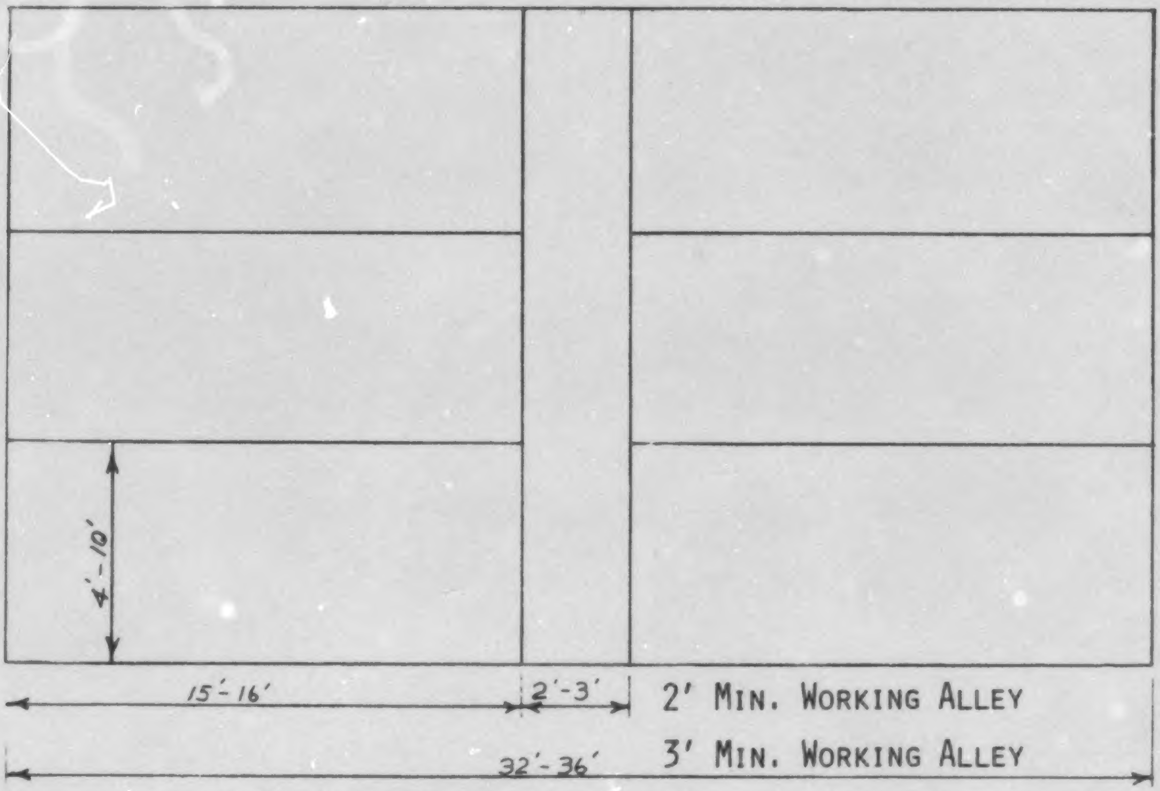
423

REDUCING LOSSES FROM STRESS

The following are some suggestions for reducing losses from stress.

1. Eliminate, minimize or reduce all types of stress.
    - A. Avoid crowding
    - B. Don't mix hogs
    - C. Treat pigs quietly at all times
    - D. Avoid sudden temperature or environmental changes

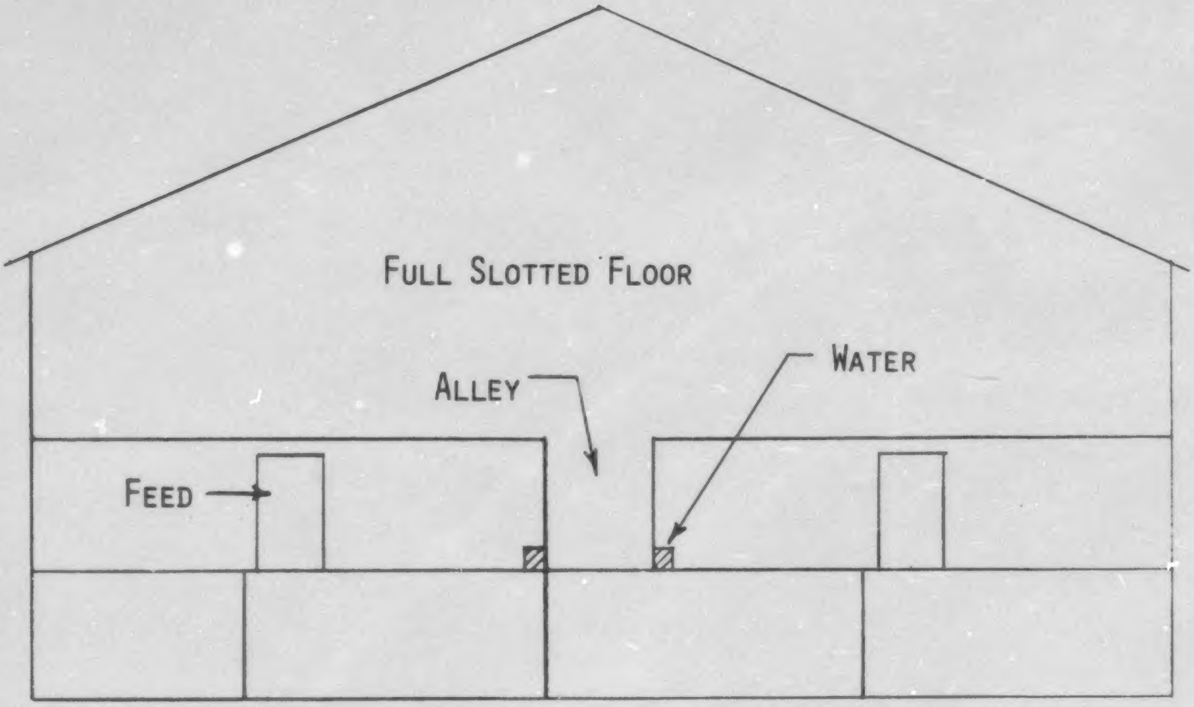
2. Other management cautions and suggestions
    - A. Do not use or allow the use of an electric prod during pig loading or unloading for marketing.
    - B. Do not feed pigs 12-24 hours prior to marketing.
    - C. Try to move pigs in the "cool of the day."
    - D. Whenever possible spread stress over long time periods.
    - E. Encourage premium to truckers delivering live healthy hogs.


4'-10'
15'-16'
2'-3'
2' MIN. WORKING ALLEY
32'-36'
3' MIN. WORKING ALLEY

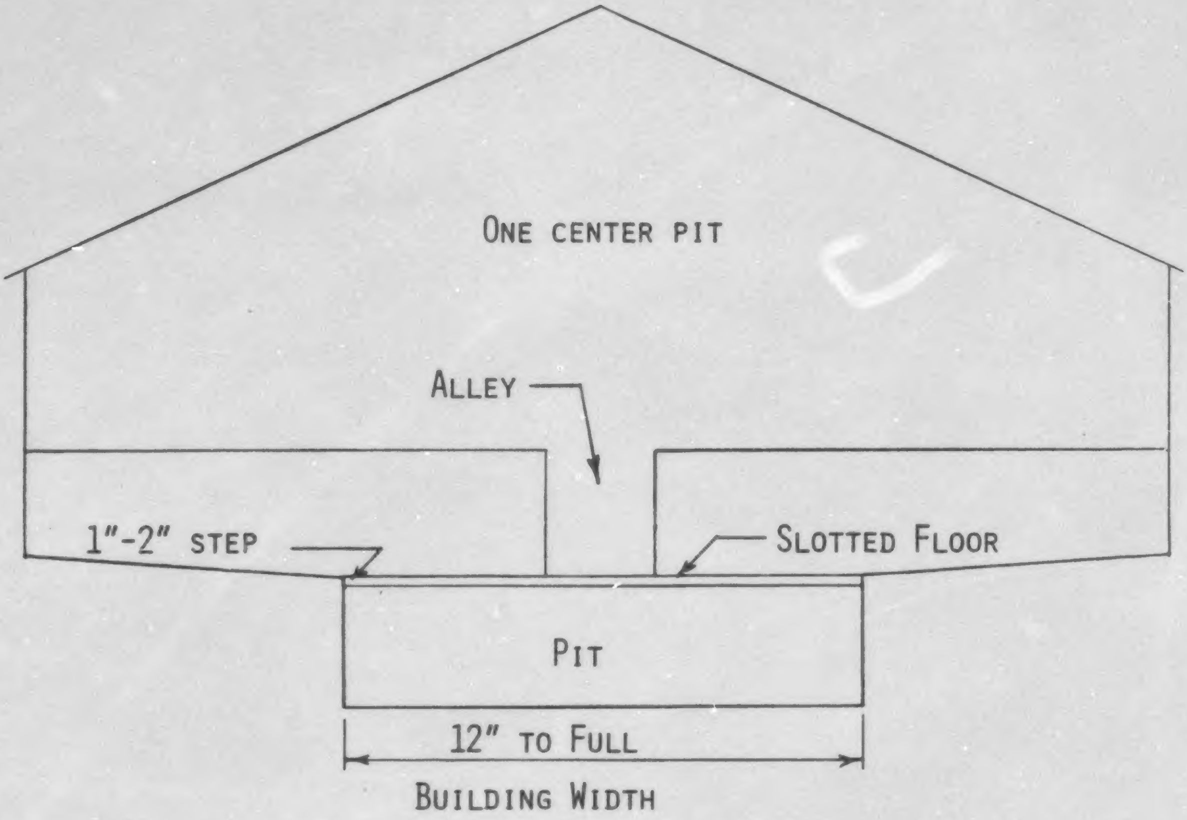
BUILDING LENGTH DEPENDS ON THE NUMBER OF PIGS TO BE FINISHED. AT 8 SQ. FT./PIG, EACH 4' x 16' PEN HOLDS 8 PIGS, AND EACH 10' x 16' PEN HOLDS 20 PIGS.

T-1

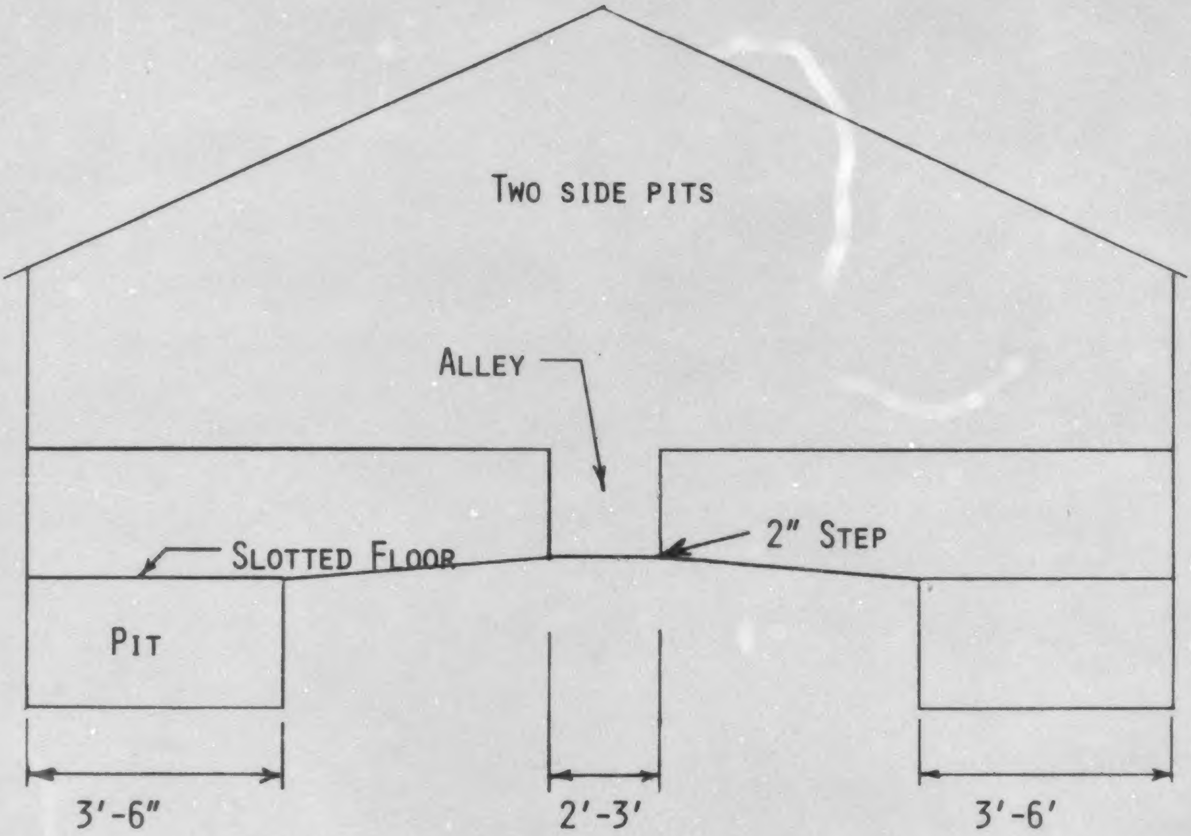
425


FULL SLOTTED FLOOR
ALLEY
WATER
FEED

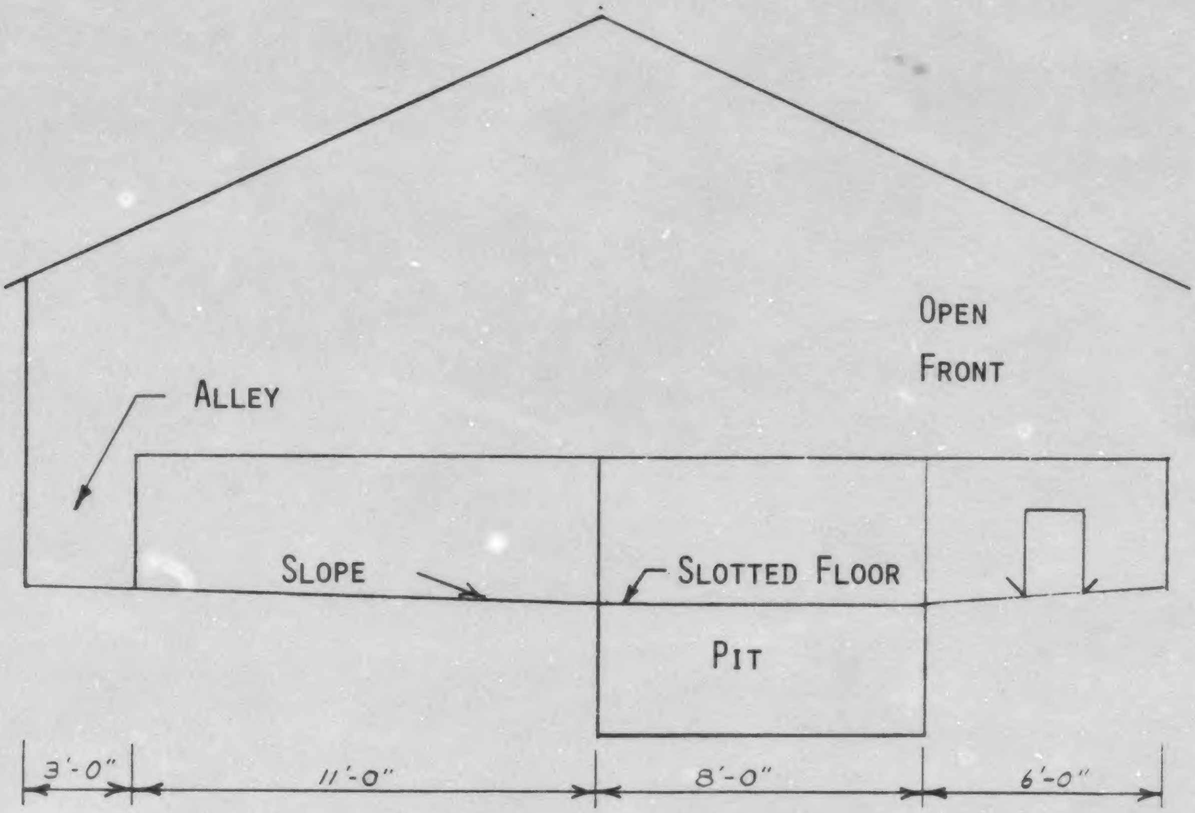
PEN SIZE AND ARRANGEMENT ARE VERY FLEXIBLE. HAND CLEANING IS MINIMIZED, AND MANURE STORAGE CAPACITY IS RELATIVELY HIGH - ABOUT 140 DAYS IN 4' DEEP PITS.


ONE CENTER PIT
ALLEY
1"-2" STEP
SLOTTED FLOOR
PIT
12" TO FULL
BUILDING WIDTH

A CENTRAL PIT IS LESS APT TO FREEZE AND SHOULD BE CHEAPER THAN TWO SIDE PITS BUT PROVIDES ACCESS ONLY AT THE ENDS FOR AGITATING AND PUMPING. THE ALLEY IS SLOTTED TO SAVE MAKING TWO PITS ONLY 2'-3' APART. A CENTRAL PIT IS EASIER TO INSTALL THAN SIDE PITS IN AN EXISTING BUILDING WITH GOOD FOOTINGS.

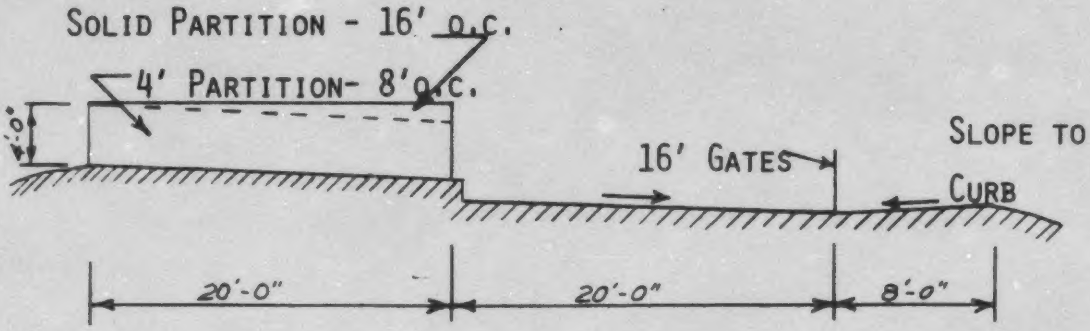

Two side pits
Alley
2" Step
Slotted Floor
Pit
3'-6"
2'-3'
3'-6'

In cold climates, insulate to the frost line along outside pit walls. Pit will hold about 60 days' wastes.


ALLEY
OPEN FRONT
SLOPE
SLOTTED FLOOR
PIT
3'-0"
11'-0"
8'-0"
6'-0"

IN WARM OR MODERATE CLIMATES, PLACE THE PIT ALONG THE OPEN WALL FOR MAXIMUM WINTER SUN EXPOSURE. IN COLD CLIMATES, ARRANGE THE PIT NEAR THE CENTER OF THE BUILDING TO AVOID FREEZING.

OPEN FRONT, OUTDOOR LOT


SOLID PARTITION - 16' O.C.
4' PARTITION- 8' O.C.
4'-0"
16' GATES
SLOPE TO
CURB
20'-0"
20'-0"
8'-0"

AN OPEN LOT ADDS TO CLEANING AND RUNNOFF CONTROL PROBLEMS. SOME UNITS USE FLOOR HEAT BOTH INDOORS AND OUT FOR COMFORT AND TO AVOID SNOW ACCUMULATION.

CHART 1

ADVANTAGES OF CONFINEMENT FEEDING OF HOGS

1. IT MAY NOT BE ECONOMICAL TO USE LAND WITH HIGH VALUE ($600 TO $1,000) PER ACRE.
2. MORE RAPID GAINS CAN BE PRODUCED WHEN PIGS ARE IN CONFINEMENT IF ADEQUATE RATION AND GOOD MANAGEMENT ARE PROVIDED.
3. CONFINEMENT FACILITIES CAN BE USED DURING MORE MONTHS OF THE YEAR THAN CAN PASTURE FACILITIES.
4. THERE IS LESS LABOR REQUIRED WHEN PIGS ARE IN CONFINEMENT FEEDING.
5. LESS LABOR AND DIFFICULTY IN PROVIDING AN ADEQUATE SUPPLY OF FEED AND WATER IS ANOTHER ADVANTAGE.
6. FENCE PROBLEMS WILL BE MINOR COMPARED TO PASTURE FEEDING.
7. THE CONFINEMENT METHOD IS BEST FOR GROWING OR FEEDING OUT LARGE NUMBERS OF HOGS ON SMALL FARMS.

BY BUNDY AND DIGGINS: LIVESTOCK AND POULTRY PRODUCTION

ORIGINAL COST

COST OF THREE DIFFERENT TYPES OF BUILDINGS USED IN PRODUCING 840 HOGS.

	TYPE OF BUILDING		
	COLD SOLID DUNGING ALLEY	COLD SLOTTED PIT	WARM ALL SLOTTED
SQUARE FEET	2400	2400	1680
COST PER SQUARE FOOT	$2.50	$3.75	$7.00
HOG CAPACITY PER YEAR	840	840	840

DENNIS M. RYAN, COLD HOG FINISHING HOUSES WITH EITHER SLATS OR BEDDING. (6)

SPACE REQUIREMENTS FOR LIVESTOCK

TOTAL	WEANING TO 75 POUNDS	75 TO 125 POUNDS	125 POUNDS AND OVER
CONFINEMENT (PER HEAD)			
SLOTTED FLOORS	4.5 SQ.FT.	6 SQ.FT.	8 QT.FT.
SOLID FLOORS	4 SQ.FT.	6-7 SQ.FT.	9 SQ.FT.
IF IN PENS, ADDITIONAL SPACE WILL BE NEEDED.	1 SQ.FT.	1 SQ.FT.	2 SQ.FT.
FEEDING HOGS PER LINEAR FEET OF FEEDERS SPACE	6 SQ.FT.	4 SQ.FT.	3-4 SQ.FT.
HOGS PER WATERING CUP	20-25	20-25	10-15
SELF FEEDER (PIGS PER HOLE)	4-6	4-6	3-5

THE TABLE SHOWS A GENERAL RANGE OF SPACE REQUIREMENTS FOR HOGS. NEW DEVELOPMENTS IN BUILDING AND EQUIPMENT WILL CHANGE THESE NEEDS. AS METHODS OF CONFINEMENT AND MECHANIZATION ARE PERFECTED, BUILDING AND FEEDER SPACE PER ANIMAL CAN BE REDUCED. IN FIGURING LINEAR FEET OF FEEDING AND WATERING EQUIPMENT, COUNT BOTH SIDES OF BUNK OR FEEDER.

DOANE'S FARM MANAGEMENT GUIDE

433

SPACE REQUIREMENTS FOR LIVESTOCK

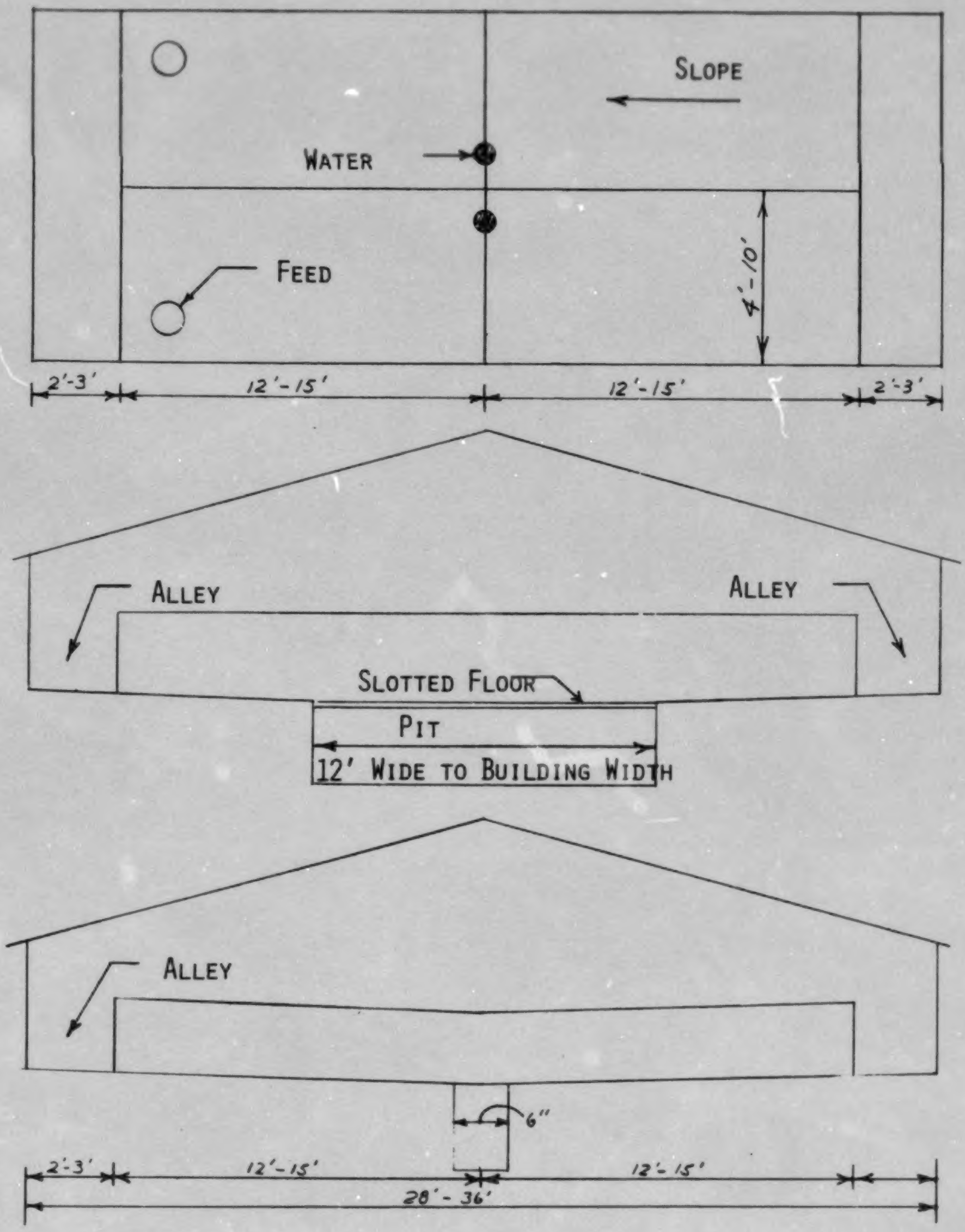
TOTAL	WEANING TO 75 POUNDS	75 TO 125 POUNDS	125 POUNDS AND OVER
SEMI-CONFINEMENT (PER HEAD)			
BUILDING FLOOR AREA (SLEEPING AREA)	6 SQ.FT.	7 SQ.FT.	8 SQ.FT.
SURFACE LOT (FEEDING AREA)	8 SQ.FT.	12 SQ.FT.	12-20 SQ.FT.
FEEDERS PER LINEAR FOOT	6 SQ.FT.	4 SQ.FT.	3-4 SQ.FT.
HOGS PER WATERING CUP	20-25	20-25	10-15

THE TABLE SHOWS A GENERAL RANGE OF SPACE REQUIREMENTS FOR HOGS. NEW DEVELOPMENT IN BUILDING AND EQUIPMENT WILL CHANGE THESE NEEDS. AS METHODS OF CONFINEMENT AND MECHANIZATION ARE PERFECTED, BUILDING AND FEEDER SPACE PER ANIMAL CAN BE REDUCED. IN FIGURING LINEAR FEET OF FEEDING AND WATERING EQUIPMENT, COUNT BOTH SIDES OF BUNK OR FEEDER.

DOANE'S FARM MANAGEMENT GUIDE

ADVANTAGES OF SLOTTED FLOORS

1. LABOR SAVED.
2. A POSSIBLE INCREASE IN VOLUME OF PRODUCTION BECAUSE OF LABOR EFFICIENCY.
3. SAVING IN BEDDING COSTS.
4. CONVENIENCE FOR THE OPERATOR.


SLOPE
WATER
FEED
4'-10'
2'-3'
12'-15'
12'-15'
2'-3'
ALLEY
ALLEY
SLOTTED FLOOR
PIT
12' WIDE TO BUILDING WIDTH
ALLEY
6"
2'-3'
12'-15'
12'-15'
28'-36'

TWO SIDE ALLEYS REQUIRE MORE BUILDING SPACE THAN ONE CENTRAL ALLEY. PENS MAY BE DIFFERENT WIDTHS, OR THE MIDDLE DIVIDER CAN BE OFF-CENTER.

RECOMMENDED MINIMUM WIDTH FOR SERVICE PASSAGES IN HOG FEEDING BUILDINGS

KIND OF PASSAGE	USE	MINIMUM WIDTH
Feed Alley	For Feed Cart	4′-0″
Driveway	For Wagon, Spreader, or Truck	9′-0″
Doors and Gates	Drive-Through	9′-0″
Doors and Gate	To Small Pens	4′-0″

The Stockman's Handbook - Table 75 - Page 345

1. The feed alley, driveway, doors, and gates are set at minimum and you should keep this in mind.

PROBLEMS OF TOTAL CONFINEMENT OF FINISHING SWINE

1. Over crowding
2. Proper ventilation
3. Odors and control
4. Manure handling
5. Hog stress
6. Cost of confinement building and equipment
7. Heating

APPROXIMATE DAILY MANURE PRODUCTION
WASTE PRODUCTION

WEIGHT (LBS.)	LIQUIDS & SOLIDS		WET SOLIDS ONLY	
	CU. FT.	GAL.	CU. FT.	LBS.
PIGS				
40	.06	.5	.04	2.4
100	.13	1.0	.1	5.9
150	.30	2.2	.2	12.0

NOTE: THE ABOVE FIGURES ARE MEDIUM VALUES FOR UNDILUTED, FRESH MANURE WITHOUT BEDDING.

SWINE HANDBOOK HOUSING & EQUIPMENT BY MV P.S. - 8

REDUCING LOSSES FROM STRESS

THE FOLLOWING ARE SOME SUGGESTIONS FOR REDUCING LOSSES FROM STRESS:

1. ELIMINATE, MINIMIZE OR REDUCE ALL TYPES OF STRESS.
    - A. AVOID CROWDING
    - B. DON'T MIX HOGS
    - C. TREAT PIGS QUIETLY AT ALL TIMES
    - D. AVOID SUDDEN TEMPERATURE OR ENVIRONMENTAL CHANGES

2. OTHER MANAGEMENT CAUTIONS AND SUGGESTIONS
    - A. DO NOT USE OR ALLOW THE USE OF AN ELECTRIC PROD DURING PIG LOADING OR UNLOADING FOR MARKETING.
    - B. DO NOT FEED PIGS 12-24 HOURS PRIOR TO MARKETING.
    - C. TRY TO MOVE PIGS IN THE "COOL OF THE DAY."
    - D. WHENEVER POSSIBLE SPREAD STRESS OVER LONG TIME PERIODS.
    - E. ENCOURAGE PREMIUMS TO TRUCKERS DELIVERING LIVE HEALTHY HOGS.

Adult Unit No. 14

FEEDING AND MANAGEMENT OF THE GESTATING SOW

A Resource Unit For Adult Education
Classes in Agriculture

Developed by
Howard Siegrist

Edited by
J. David McCracken

Department of Agricultural Education
College of Agriculture and Home Economics
The Ohio State University
Columbus, Ohio 43210

1975

441

PREFACE

THIS RESOURCE UNIT WAS DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U. S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN	L. H. NEWCOMB
ASSISTANT PROFESSOR	ASSISTANT PROFESSOR

442

TABLE OF CONTENTS

PAGE

Preface III

Introduction 1

State Situation 3

Local Situation 3

Objectives 3

References 3

Needed AV Equipment 4

Alternative Interest Approaches 4

Questions to be Answered 4

Learning Activities 5

Appendix A: Content Summary 6

Appendix B: Instructional Materials 14

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

444

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATIBLE TO THE LOCAL COMMUNITY.

FEEDING AND MANAGEMENT OF THE GESTATING SOW

State Situation

Swine producers in the F.B.P.A. program averaged 34.7 and 49.8 sows and gilts per farm in 1972 and '73 respectively. The average pigs weaned per litter was 8.31 and 7.9 in 1972 and '73 respectively. An increase of approximately 43 percent in the number of sows and gilts per farm and a 5 percent decrease in pigs weaned per litter occurred between 1972 and 1973.

Local Situation

Problems, concerns, apprehensions of local farmers in feeding and management of gestating swine can be obtained through on the farm visits, discussions with the county agent, discussions with key farmers, and surveys of concerns of members of an adult farmer or young farmer class.

Objectives

The class members are to:

1. Identify the ration needs of the gestating sow.
2. Identify the management practices necessary to ensure herd health.
3. Identify the advantages of a sow versus gilt breeding program.

References

Bundy, Clarence E. and Diggins, Ronald V. *Livestock and Poultry Production*. 4th Ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1974.

Caring For The Swine Herd During Breeding and Gestation. Urbana, Illinois: University of Illinois; College of Agriculture; Vocational Agriculture Service.

Moyer, Wendell; Koch, Berl A. *Swine Nutrition*. Kansas State University, Extension Service, December, 1964.

National Hog Farmer. Swine Information Service, Revised January, 1968.

Swine Feeds and Feeding. Urbana, Illinois: University of Illinois, College of Agriculture, Vocational Agriculture Service.

SWINE PRODUCTION RESOURCE UNIT. COLUMBUS, OHIO: DEPARTMENT OF AGRICULTURAL EDUCATION, THE OHIO STATE UNIVERSITY, VOCATIONAL AGRICULTURE SERVICE, OHIO DEPARTMENT OF EDUCATION, 1962.

WILSON, DR. RICHARD F. GESTATION-LACTATION PERIOD MANAGEMENT OF SOWS AND GILTS. DEPARTMENT OF ANIMAL SCIENCE, THE OHIO STATE UNIVERSITY, FEBRUARY, 1964.

YOUR HOG BUSINESS. URBANA, ILLINOIS: UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN, COOPERATIVE EXTENSION SERVICE, COLLEGE OF AGRICULTURE, NOVEMBER, 1970.

NEEDED AV EQUIPMENT

CHALKBOARD, OVERHEAD PROJECTOR AND SCREEN, AND SLIDE PROJECTOR.

ALTERNATIVE INTEREST APPROACHES

ALTERNATIVE A. CONDUCT SURVEY OF CLASS MEMBERS OF FEEDING METHOD, PERCENT CRUDE PROTEIN, PARASITE CONTROL PROGRAM, ETC. OF EACH CLASS MEMBER ON THE BLACKBOARD OR PREPARE AN OVERLAY ON THE OVERHEAD PROJECTOR

ALTERNATIVE B. ASK THE CLASS MEMBERS WHAT ASPECT OF THEIR GESTATING SWINE MANAGEMENT PROGRAM COULD MAKE THEM THE MOST MONEY IF IMPROVED. ASK THEM WHY THEY HAVE COME TO THE CONCLUSION THEY HAVE. HOW CAN IT BE IMPROVED?

ALTERNATIVE C. SHOW SLIDES OF CLASS MEMBERS FARM SITUATIONS FEATURING HOUSING, FEEDING PROGRAMS, AND SANITATION PRACTICES OF LOCAL FARMERS. ALSO, PICTURES PRESENTING UNIVERSITY FACILITIES MAY HELP IN GENERATING INTEREST AND DISCUSSION.

ALTERNATIVE D. HAVE SAMPLES OF FEEDS FED ON LOCAL FARMS AT MEETING TO GENERATE DISCUSSION. IF RATION ANALYSIS HAVE BEEN COMPUTED LATELY, COMPARISON OF RESULTS WILL STIMULATE THOUGHT AND INTEREST. BRING IN SAMPLES OF PRODUCTS USED FOR INTERNAL AND EXTERNAL PARASITE CONTROL FROM LOCAL FARM SUPPLY CENTERS.

ALTERNATIVE E. SHOW THE FILMSTRIP "MADAM SOW" TO INTRODUCE THE UNIT. (AVAILABLE FROM OHIO CURRICULUM MATERIALS SERVICE.)

QUESTIONS TO BE ANSWERED

1. WHAT ARE THE NUTRIENT REQUIREMENTS OF A GESTATING SOW?
2. WHAT MANAGEMENT PRACTICES SHOULD I USE TO MAINTAIN HERD HEALTH?
3. WHAT ARE THE ADVANTAGES OF A SOW OR GILT BREEDING PROGRAM?

LEARNING ACTIVITIES

1. WHAT ARE THE NUTRIENT REQUIREMENTS OF A GESTATING SOW?

USE HANDOUT #1 TO DISCUSS NUTRITIONAL REQUIREMENTS OF THE SOW.

USE HANDOUTS #2-3 TO DISCUSS OPTIONAL RATIONS FOR USE DURING GESTATION.

USE TRANSPARENCY #2 TO SHOW SILAGE REPLACEMENT OF CORN AND SUPPLEMENT.

USE TRANSPARENCY #3 TO CONSIDER THE MOST ECONOMICAL FEEDING METHOD FOR YOUR OPERATION.

2. WHAT MANAGEMENT PRACTICES SHOULD I USE TO MAINTAIN HERD HEALTH?

USE TRANSPARENCIES #5-6 TO DISCUSS SANITATION PRACTICES AND ANTIBIOTICS AS DISEASE PREVENTION AND PARASITE CONTROL.

3. WHAT IS THE MOST ECONOMICAL FEEDING METHOD?

USE TRANSPARENCIES #3-4 TO DISCUSS VARIOUS FEEDING METHODS.

APPENDIX A

CONTENT SUMMARY

1. FEEDING AND MANAGEMENT OF THE GESTATING SOW
2. GESTATION-LACTATION PERIOD MANAGEMENT OF SOWS AND GILTS
3. FEEDING THE SOW DURING PRE-BREEDING AND BREEDING SEASON
    - A. FEEDING DURING GESTATION
    - B. FEEDING DURING LACTATION

FEEDING AND MANAGEMENT OF THE GESTATING SOW

1. GILTS TO BE RETAINED FOR THE BREEDING HERD SHOULD BE KEPT SEPARATE FROM OLDER SOWS.

2. MANGE AND LICE TREATMENT IS RECOMMENDED DURING GESTATION.

3. KEEP BOARS AND SOWS FREE OF DRAFT IN THE WINTER AND AS COOL AND COMFORTABLE AS POSSIBLE IN THE SUMMER. THE SQUARE FEET OF HOUSING OR SHADE PER ANIMAL SHOULD BE AS FOLLOWS:

GILTS	WINTER--15 SQ. FT.	SUMMER--17 SQ. FT.
BOARS	WINTER--18 SQ. FT.	SUMMER--20 SQ. FT.

4. HAND FEEDING OF SOWS AND GILTS DURING GESTATION IS GENERALLY RECOMMENDED AS GREATER UTILIZATION OF PASTURE AND OTHER DESIRABLE ROUGHAGES CAN BE ATTAINED AND THE CONDITION OF THE SOWS AND GILTS CAN BE MORE CLOSELY WATCHED BUT SPECIALLY ADAPTED BULKY RATIONS CAN BE SUCCESSFULLY SELF-FED. KEEP SOWS AND GILTS FROM GETTING TOO FAT.

5. WHEN SOWS AND GILTS ARE SELF-FED DURING GESTATION THE NUMBER PER LINEAR FOOT OF FEEDER SPACE, OR SELF-FEEDER HOLE SHOULD BE AS FOLLOWS: PASTURE, 3 TO 4; AND DYLOT, 2 TO 3.

6. FOR HAND FEEDING IN TROUGHS OF GILTS OR SOWS DURING GESTATION OR FOR HAND WATERING THE LINEAR FOOT OF SPACE REQUIRED PER SOW OR GILT IS 1 1/2 TO 2 FEET.

7. BRED SOWS AND GILTS MAY BE USED TO GLEAN CORN LEFT IN FIELDS, PROVIDING AN EXCESSIVE AMOUNT OF CORN IS NOT ON THE GROUND AND A SUPPLEMENT IS AVAILABLE.

8. ONE AUTOMATIC WATERING CUP SHOULD BE PROVIDED FOR EACH 12 GILTS OR SOWS.

9. FEEDING SHOULD BE REGULATED TO ALLOW FOR .6 TO 1# OF GRAIN PER HEAD PER DAY DURING PREGNANCY. THE RATION SHOULD PROVIDE A 15% CRUDE PROTEIN RATE. FEED INTAKE SHOULD BE LIMITED TO APPROXIMATELY 4-5# PER HEAD PER DAY. EXCESS GAIN MAY BE DAMAGING TO LITTER SIZE AND BIRTH WEIGHTS.

10. RATIONS SHOULD BE FORTIFIED WITH A PROPER PORTION OF MINERAL SUPPLEMENT. (REFER TO "YOUR HOG BUSINESS--RATION SUGGESTIONS," CIRCULAR 1023, UNIVERSITY OF ILLINOIS.)

11. INDIVIDUAL FEEDING STALLS ARE DESIRABLE.

    A) MORE EQUIPMENT AND LABOR, ESPECIALLY IF FEMALES ARE LOCKED IN STALLS TO EAT.

B) MAINTAIN CERTAIN DEGREE OF CONDITION.

C) STALLS NEED ONLY BE ABOUT 18" WIDE AND ABOUT 5' LONG. YOU MAY OR MAY NOT LOCK THEM IN TO EAT.

D) CAN USE STALLS TO ADMINISTER INJECTIONS, ETC.

12. OHIO STATE UNIVERSITY HAND FEEDING RATION: 10# T.M. SALT, 1/2# VIT. D, 1# VIT. A, 1079# GROUND SHELLED CORN, 120# M & B SCRAPS, 400# GROUND OATS, 160# SBOM, 200# ALFALFA MEAL, 30# MINERAL MIX.

13. INTERNAL PARASITE CONTROL SHOULD BE COMPLETED USING ANY RECOMMENDED WORMING PRIOR TO BREEDING OR IN EARLY GESTATION - E.G. ATGARD.

GESTATION-LACTATION PERIOD MANAGEMENT OF SOWS AND GILTS

WHAT CAN BE DONE TO INSURE THAT THE MOST NUMBER OF SOWS BRED WILL SETTLE AND WILL FARROW LARGE LITTERS OF LIVING PIGS?

THE FOLLOWING SLIDE SERIES AND SCRIPT WAS PREPARED BY DR. RICHARD F. WILSON, DEPARTMENT OF ANIMAL SCIENCE, THE OHIO STATE UNIVERSITY, FOR A GESTATION-LACTATION TALK GIVEN IN FEBRUARY OF 1964. DR. WILSON HAS MADE THE SLIDES AND SCRIPT AVAILABLE TO THE OHIO VOCATIONAL AGRICULTURE INSTRUCTIONAL MATERIALS SERVICE.

1. BREED GILTS WHEN 8 TO 9 MONTHS OLD (TO FARROW AT YEAR OF AGE) INSTEAD OF YOUNGER. BREEDING DURING THEIR THIRD HEAT PERIOD INCREASES NUMBER OF PIGS FARROWED BY 2 1/2 PIGS PER LITTER (WIS.). PIGS MAY BE LARGER AND THUS BETTER SURVIVAL AND MORE MILK BY DAM.

2. BREED THEM AT LEAST TWICE DURING THE HEAT PERIOD IF HAND BREEDING, ONCE WHEN FIRST IN HEAT AND AGAIN THE NEXT DAY. IF DON'T WISH TO HAND BREED, CAN PEN BREED (PUT SOWS IN HEAT WITH BOAR AND LIVE WITH BOAR WHILE IN HEAT). BREED THEM TO SEVERAL BOARS IN THE SAME HEAT PERIOD IF NOT PUREBREDS (SEEMS TO BE A DIFFERENCE IN COMPATABILITY). CAN RUN TWO BOARS TOGETHER WITH FEMALES OR ONE FOR ONE DAY AND ONE FOR THE NEXT.

3. KEEP SELECTING FOR LITTER SIZE EVEN THOUGH HERITABILITY IS ONLY ABOUT 5-15% (102). MAY TAKE ABOUT TWENTY GENERATIONS TO INCREASE SIZE OF LITTER ONE PIG. DEPENDS WHERE YOU START. (MARK GILTS OF LARGE LITTERS WITH NOTCHES SO YOU CAN IDENTIFY THEM - BEFORE PIGS ARE WEANED.) KEEP "SOWS." WHERE FARROWING OFTEN. SOW INCREASES IN NUMBER OF PIGS UP TO 2 1/2 TO 3 YEARS AND THEN STAYS CONSTANT UNTIL ABOUT 5 YEARS. (INCREASE FROM 1ST YO 3RD LITTERS MAY BE 1 1/2 PIGS PER LITTER.) HEAVIER PIGS AT BIRTH, MORE MILK, HEAVIER PIGS AT WEANING. MUST KEEP SOWS SEPARATE FROM GILTS DURING BREEDING AND GESTATION IF NOT SELF-FEEDING OR STALL FEEDING.

4. SELECT SOWS WITH "SOME" LENGTH OF BODY AND AT LEAST 12 FUNCTIONAL, WELL-SPACED TEATS.
IF OLDER BOARS CAN BE USED, USE BOAR THAT HAD PRODUCED GOOD CONCEPTION AND LARGE LITTERS. (IN NORWAY BOARS VARIED FROM 37 TO 60% CONCEPTION.)
SELECT BREED OR BREEDS WITH LITTER SIZE IN MIND. YORKS (10-11) GENERALLY ON TOP, A COUPLE ON THE BOTTOM WITH 6-8, AND THE REST ARE BETWEEN (9-10).

5. KEEP FEMALES COOL IF POSSIBLE DURING BREEDING AND GESTATION (SPRINKLE).
OKLAHOMA REPORTED: SPRINKLED - 10.9 PIGS TOTAL, STILLBORN .82 PIGS.

UNSPRINKLED - 9.2 PIGS TOTAL, STILLBORN 1.53 PIGS.

6. CROSSBREED FOR COMMERCIAL PRODUCTION. CROSSBRED MOTHERS ARE BETTER MOTHERS, MORE MILK, MORE PIGS SURVIVE TO WEANING, HEAVIER PIGS AT WEANING AND THEREFORE, HEAVIER PIGS AT MARKET.
DON'T INBREED. ONE-THIRD LESS PIGS PER LITTER FARROWED FOR EACH 10% IN-BREEDING OR ONE-HALF PIG LESS PER LITTER AT WEANING. (LESS SURVIVAL FROM FARROWING TO WEANING AND MORE BREEDING TROUBLES. BOARS MAY NOT HAVE LIBIDO AND SOWS MAY HAVE TROUBLE SETTLING.) (BROTHER-SISTER MATING PRODUCES 25% INBREEDING. SAME FOR SIR-DAUGHTER OR SON-DAM MATING.)

7. DON'T HAVE FEMALES FAT OR TOO THIN WHEN GOING INTO BREEDING SEASON. HAVE MEDIUM CONDITION.
CHECK FOR BRUCELLOSIS, LEPTO AND DON'T BREED WHILE SOWS HAVE FLU. ANY HIGH BODY TEMPERATURE FOR A DAY OR MORE MAY CAUSE ABORTION. EARLY IN GESTATION MAY BE MOST VULNERABLE TIME.
FLUSH FEMALES IF POSSIBLE - FEED THEM BETTER THAN THEY HAVE BEEN USED TO, IF POSSIBLE.

- SOWS THAT HAVE JUST WEANED PIGS IT MAY EFFECT MILK FLOW. THIS MAY NOT HARM UDDER. SO PROBABLY WILL FLUSH ANYWAY.

- GILTS MAY BE FAT ENOUGH AT START OF FLUSHING. SHOULD HAVE SEPARATED GILTS AT 150 LBS. AND FED LESS COSTLY, MORE BULKY RATION THAN THE MARKET HOGS SO YOU CAN FLUSH THEM.

- THEN DURING GESTATION HAVE GILTS GAIN ABOUT 80-100 LBS. 40-60 LBS MAY NOT BE ENOUGH; 100-140 LBS. MAY BE TOO MUCH. MO. HAD MOST PIGS WITH 80-100 LBS. GAIN. TRY TO MAINTAIN 1 LB. PER DAY GAIN OR LITTLE LESS. SOWS MAY NEED LESS GAIN, DEPENDING ON CONDITION AT START.

- FEED GILTS ABOUT 4-6 LBS. OF FEED PER HEAD PER DAY OR 1 1/2 - 2 LBS. PER 100 WT. PER DAY.

- FEED SOWS 1.2 - 1.5 LBS. PER 100 LBS. BODY WEIGHT PER DAY OR ABOUT 5-6 LBS. PER HEAD PER DAY. IS ENOUGH BECAUSE SOWS NOT GROWING AS MUCH.

- Often increased to 7-8 lbs. per day last 1/3 of pregnancy.

8. Individual feeding liked:

- More equipment and labor, especially if females locked in stall to eat.

- Can maintain certain degree of condition.

- Stalls need only be about 18" wide and about 5' long. May or may not lock them in to eat.

- Can use the stalls to administer injections, etc.

9. Ohio State is hand feeding at present:

Gr. Sh. Corn	1079 lbs.	D. Alf. Meal	200 lbs.
M&B Scraps	120	Min. Mix.	30
Gr. Oats	400	T. M. Salt	10
S B O M	160	Vit. D. (4 mil. units/lbs.)	1/2
		Vit. A (5000 units/lb.)	1
C.P. % Approx. 15.3			2000 lbs.
			1/2 oz.

10. If self fed, bulk up ration with ground corn cobs, ground alfalfa meal, oat hulls, etc. Sow need more bulk than gilts, takes good feeders.

Ground Ear Corn	760 lbs.	Meat & Bone Scrpas	100 lbs.
Ground Oats	700	Mineral Mix	30
Alfalfa Meal	300	T. M. Salt	10

Irra. Yeast 6 oz.

OR

11.

Ground Corn Cobs	700 lbs.)	
Ground Shelled Corn	600 lbs.)	750 lbs. Ear Corn and 550 lbs.
Alfalfa Meal	200 lbs.)	ground corn cobs
Sow Supplement	500 lbs.)	

12. Can feed silage, either grain silage, legume or grass legume.

- Apparently need corn silage free choice and

2 lbs. Shelled Corn
1.5 lbs. Sow Supplement
(36-38% C.P. with vitamins and minerals)

or free choice alfalfa silage.

2 lbs. Ground Corn
.5 lbs. Sow Supplement

Try to maintain 1 lb. gain per day.

13. Pre-Farrowing and Farrowing

- Put in farrowing pen or stall about 5-7 days before due to farrow (use 114 days). Some want to have sow in longer to get her used to the pen.

- If she fights farrowing stall, take her out for she may kill herself. If pigs are being overlaid, will save pigs. Doesn't take place of attendant at farrowing time.

- Can leave her in farrowing stall continuously or take her out and feed her. Less cleaning. Need pens and sows marked, if many.

- Reduce her feed some. May put bran (up to 1/3 of her feed) or some linseed meal to keep her from getting constipated.

14. If in pen, use guard rails around sides, have brooder, if stall is used it has best advantage in winter because of heat drawing pigs away from sows.

15. Be present at farrowing. Dry pigs off and see that he breathes. May keep pigs away from nervous sow until all pigs farrowed, then stay with pigs until suckle.

- Transfer pigs. This will save pigs, maybe 1 more per litter. This must be done early. Biggest pigs to older litters, smaller pigs to younger litters.

16. Prevent overlaying by stalls, guard rails, small pieces of bedding, and don't feed in pens. (Indiana study showed 50% of the pigs lost were overlaid.) Greatest loss comes within the first 3 days:

16% Starvation
9% Digestive difficulties
1% Chilling
.2% Respiratory difficulties
13.8% unknown

- Remove needle teeth. Cooling farrowing facility.

17. Creep feeding

- Greatest milk production at about third week.

- Have pig eat 5 lbs. of creep feed between 14th and 35th day.

  Have pig eat 20 lbs. of creep feed between 35th and 56th day.

- Want 40 lbs. average per pig in the litter at 8 weeks.

- Creep feed doesn't have to be exceptionally complete because it supplements milk.

- Allow maximum of 5 pigs per linear foot of feeder space or per feeder hole.

- Have creep sheltered and near sow feeder and house.

18. The following creep rations have been used:

Wooster

Rolled Oats	63.3 lbs.
Cracked Corn	31.8
Dried fish solubles	4.0
T. M. Salt	0.4
Antibiotics (10 grams/lb.)	0.5

19. Creep feed - On pasture or on dry lot.

University

Ground shelled corn	958
Middlings	200
Rolled oats, feeding grade	400
Meat and bone scraps	250
Soybean oil meal	150
Minerals (commercial)	32
Vit. D. (4 million units per lb.)	5 oz.
Antibiotic (10 gms. auromycin hydrochloride/lb.)	4
Vit. B_{12} supp. (15 milligrams/lb.)	3
Vitamin supp. (2 gms. of riboflavin, 4 gms. pantothenic acid, 9 gms. of niacin, 10 gms. of choline chloride.)	2.8
	1999.8 lbs.

Approx. % C.P. 18.2

20. Vaccinate for cholera when pigs on sows if possible. After 4 weeks of age if on immunized sows and 2 weeks before weaning if wean at 8 weeks. If wean at 5-6 weeks, do it about 8 weeks.

21. Put not over 6 sows and litters per lot on pasture. Put not over 4 sows and litters per pen on concrete.

- Have sows and pigs on "clean" pasture. Allow 6-8 sows and litters per acre.

- Have enough shade and shelter space on pasture. Allow 50 sq. ft. per gilt and litter and 60 sq. ft. per sow and litter.

- Self feed sows a complete mixed ration for maximum milk production. Allow one feeder hole or linear foot of feeder space per sow or minimum of 1 1/2 foot of trough space. Ground corn plus sow and pig supplement - min. 15-16% C.P. ration, max. 6% C.F., MIN. .65% CA., MIN. .5% P. SELF WATER FOR MAXIMUM MILK PRODUCTION.

22. COMPLETELY EMPTY FARROWING AND NURSING FACILITIES BETWEEN GROUPS OF FEMALES FARROWED. CLEAN AND AIR FOR AT LEAST A WEEK.

23. TAKE SOWS AWAY FROM PIGS AT WEANING INSTEAD OF OTHER WAY.

FEEDING THE SOW DURING PRE-BREEDING AND BREEDING SEASON

GILTS AND SOWS ARE NOT LIKELY TO PRODUCE A NORMAL NUMBER OF OVA DURING THE ESTRUS PERIOD IF THEY HAVE BEEN FED IMPROPERLY. LITTER SIZE IS DETERMINED BY OVULATION RATE WHICH IS CLEARLY AFFECTED BY FEEDING. FLUSHING GILTS AND SOWS FOR A WEEK TO 10 DAYS PRIOR TO BREEDING PRODUCES AN INCREASE IN THE OVULATION RATE.

FEEDING DURING GESTATION

THE HAND FEEDING OF BROOD SOWS AND GILTS DURING THE GESTATION PERIOD IS A GOOD WAY TO SAVE FEED. A DAILY FEEDING OF 3-5 POUNDS OF A HIGH QUALITY, CONCENTRATED RATION IS USUALLY SUFFICIENT FOR SOWS AND GILTS DURING GESTATION. SOWS AND GILTS KEPT IN A THIN-TO-MEDIUM CONDITION WILL FARROW AS MANY OR MORE PIGS AND WILL DEVELOP FEWER PROBLEMS AT FARROWING TIME.

FEEDING DURING LACTATION

THE FEED REQUIREMENTS OF THE SOW AND GILT DURING LACTATION ARE CONSIDERABLY GREATER THAN DURING GESTATION. THE ABRUPT CHANGE FROM A GESTATING TO A LACTATING CONDITION IS A CRITICAL PERIOD. THE SOW IS USUALLY NERVOUS AND MAY BE FEVERISH. THEREFORE, IT IS RECOMMENDED THAT FEED BE RESTRICTED AND FRESH WATER BE AVAILABLE AT ALL TIMES. ON THE SECOND DAY, FEED 3 TO 4 POUNDS OF A HIGH QUALITY RATION AND GRADUALLY INCREASE THE AMOUNT UNTIL THE SOW IS ON FULL FEED IN APPROXIMATELY 10 DAYS. IT IS RECOMMENDED THAT SOWS AND GILTS BE FED AT A RATE APPROXIMATELY 3 PERCENT OF THEIR BODY WEIGHT.

APPENDIX B

INSTRUCTIONAL MATERIALS

HANDOUTS

- H-1: FEEDING DURING GESTATION
- H-2: RATIONS FOR PREGESTATING AND GESTATING SOWS AND GILTS
- H-3: RATIONS FOR GESTATING AND LACTATING SOWS AND GILTS

TRANSPARENCIES

- T-1: FEEDING SILAGE
- T-2: GOOD PRODUCTION METHODS
- T-3: METHODS OF FEEDING
- T-4: FEEDING
- T-5: CONTROLLING DISEASES AND PARASITES
- T-6: ROUNDWORM LIFE CYCLE

FEEDING DURING GESTATION

Nutritional Allowances	14-16% Protein
	0.6 % Calcium
	0.4 % Phosphorus
	1500 Units Vitamin A
	100 Units Vitamin D per lb.
	1.5 mg. per lb. riboflavin
	8.0 mg. per lb. niacin
	6.0 mg. per lb. pantothenic acid
	5.0 mg. per lb. antibiotics
	5.0 mg. per lb. of Vit. B_{12}
	0.5% of salt
Gain Desired	75-125 lbs. in gilts
	75-100 lbs. in sows
Amount of Feed Required	1.5-2.0 lbs. feed/100# wt. for gilts
	1.0-1.5 lbs. feed/100# wt. for sows

RATIONS FOR PREGESTATING AND GESTATING
SOWS AND GILTS

Ingredients	Hand Fed (Pounds)		Self-fed (Pounds)	
Ground corn	1,518	1,538	1,200	600
Ground oats	-	-	400	600
Ground alfalfa (hay or meal)	200	-	-	600
Soybean meal (44%)	175	400	-	-
Meat and bone scraps	75	-	-	-
Commercial sow supplement (35%)	-	-	400	200
Dicalcium phosphate	10	25	-	-
Ground limestone	-	15	-	-
Iodized salt[1]	10	10	-	-
Trace mineral premix[2]	2	2	-	-
Vitamin premix[3]	10	10	-	-

Iowa State University

1. If trace mineralized salt is used, the trace mineral premix may be omitted.

2. Trace mineral premix should contain 7% iron, 0.45% copper, 5.5% manganese, 8% zinc, and 0.15% cobalt.

3. The vitamin premix should contain 3 million I.U. vitamin A, 800,000 I. U. vitamine D, 4 gms. riboflavin, 8 gms. pantothenic acid, 18 gms. niacin, and 20 mgs. vitamin B_{12}.

RATIONS FOR GESTATING AND LACTATING SOWS AND GILTS

Ingredients †	Ration 1[1]	2[3]	3[2]	4[2]	Protein Supplement
Good pasture					
Percent protein	15.3	14.3	14.7	13.4	38.2
Ground shelled corn	74.5	83.3	32.0		
Ground ear corn				45.0	
Ground oats			30.0		
Soybean oil meal (44%)	10.0	10.0	4.0	6.0	45.0
Meat and bone scraps (50%)	5.0	5.0	3.0	3.0	27.0
Dehydrated alfalfa meal (17%)	10.0				25.0
Alfalfa meal or ground alfalfa hay			30.0	15.0	
Iodized salt	0.5	0.5	0.5	0.5	2.0
Limestone		0.3			1.0
Bone meal		0.4	0.5	0.5	
Vitamin A	30,000 I.U.				400,000 I.U.
Vitamin D	6,600 I.U.				80,000 I.U.
Riboflavin	0.1 gm.			0.05 gm.	0.5 gm.
Pantothenic acid	0.3 gm.			0.1 gm.	2.0 gms.
Niacin	0.5 gm.				2.5 gms.
Vitamin B_{12}	0.5 gm.	0.5 gm.	0.4 gm.	0.4 gm.	2.5 gms.

University of Missouri

† All ingredients in pounds unless otherwise noted.

1. Hand fed during gestation and lactation periods.

2. Self-fed during gestation.

3. Fed throughout gestation and lactation.

FEEDING SILAGE

CORN SILAGE FREE CHOICE

2 LBS. SHELLED CORN

1.5 LBS. SOW SUPPLEMENT

(36-38% C.P. WITH VITAMINS AND MINERALS)

ALFALFA SILAGE FREE CHOICE

2 LBS. GROUND CORN

0.5 LBS. SOW SUPPLEMENT

MAINTAIN ONE LB. GAIN PER DAY BY INCREASING OR DECREASING AMOUNT OF GRAIN.

GOOD PRODUCTION METHODS

WILL RESULT IN

1. MORE PIGS BEING FARROWED PER SOW
2. LARGER AND HEALTHIER PIGS AT BIRTH
3. FEWER DEAD PIGS, RUNTS, AND ABNORMAL PIGS PER LITTER
4. BETTER PRODUCTION OF MILK BY THE SOWS
5. MORE AND HEAVIER PIGS WEANED PER LITTER

METHODS OF FEEDING

HAND FEEDING -

ALLOWS GREATER UTILIZATION OF PASTURE AND OTHER ROUGHAGES.

CONDITION OF ANIMALS CAN BE WATCHED MORE CLOSELY.

SELF FEEDING -

REQUIRES LESS LABOR.

REQUIRES MORE BULK IN RATION.

INDIVIDUAL FEEDING STALLS -

REQUIRE MORE LABOR AND EQUIPMENT.

ALLOWS GREATEST PRECISION IN FEEDING.

MOST EFFICIENT USE OF FEED.

T-3

FEEDING[1]

1. FLUSH SOWS BY FULL-FEEDING A 12-PERCENT PROTEIN RATION FOR 7 TO 10 DAYS BEFORE THE BREEDING SEASON STARTS AND CONTINUE UNTIL THE SOWS ARE BRED.
2. DURING GESTATION, FEED FOUR POUNDS OF 12-PERCENT RATION DAILY IN DRYLOT, DURING THE FIRST 80 DAYS OF GESTATION. IF SOWS TEND TO BE LEAN AT THIS TIME, INCREASE THE AMOUNT TO 5 POUNDS DAILY THE LAST THIRD OF THE GESTATION PERIOD.
3. FULL-FEED OR HAND FEED A 16-PERCENT RATION, STARTING THE DAY THE SOWS COME TO THE FARROWING HOUSE AND CONTINUING THROUGH LACTATION.

---

[1] "APPROVED PRACTICES FOR SWINE." VOCATIONAL AGRICULTURE SERVICE, URBANA, ILLINOIS, OCTOBER, 1973.

CONTROLLING DISEASES AND PARASITES

1. KEEP PIGS IN CLEAN AREA BY ROTATING PASTURE EACH YEAR AND BY "SANITATION BREAKS" FOR CONCRETE CONFINEMENT UNITS.

2. TEST BREEDING HERD FOR BRUCELLOSIS AND LEPTOSPIROSIS.

3. DEWORM PREGNANT SOWS AND GILTS FROM ONE TO THREE WEEKS BEFORE FARROWING.

ROUNDWORM LIFE CYCLE

1. Worm eggs containing young worms are picked up from ground or grass and swallowed.
2. Eggs hatch in intestines - then microscopic worms penetrate the intestinal walls.
3. After burrowing into intestinal wall, young worms enter blood stream, and are carried to liver and heart.
4. From liver and heart, young worms go to lungs - by way of blood stream - lodge here and grow.
5. After a few days in the lungs, young worms migrate or are coughed up windpipe into back of mouth and swallowed.
6. Young worms return to the intestines after being swallowed. They grow to maturity in about 2 months. Adult female may contain 26 to 27 million eggs.
7. Undeveloped worm eggs pass out of body in feces. Eggs not infective in this stage.
8. Incubation of worm eggs begins. In a few weeks young worms form inside the eggs on the ground. Eggs now infective.

ADULT UNIT NO. 15

ECONOMIC ASPECTS OF SWINE PRODUCTION FOR 1974-75

A RESOURCE UNIT FOR ADULT EDUCATION CLASSES IN AGRICULTURE

DEVELOPED BY
ADRIAN E. ROBERTS

EDITED BY
J. DAVID MCCRACKEN

DEPARTMENT OF AGRICULTURAL EDUCATION
COLLEGE OF AGRICULTURE AND HOME ECONOMICS
THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO 43210

1975

PREFACE

THIS RESOURCE UNIT WAS DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U. S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN
ASSISTANT PROFESSOR

L. H. NEWCOMB
ASSISTANT PROFESSOR

TABLE OF CONTENTS

PAGE

PREFACE III

INTRODUCTION 1

NATIONAL AND STATE SITUATION 3

LOCAL SITUATION 3

OBJECTIVES 3

REFERENCES 3

NEEDED AV EQUIPMENT 4

ALTERNATIVE INTEREST APPROACHES 4

QUESTIONS TO BE ANSWERED 4

LEARNING ACTIVITIES 5

TO SUMMARIZE (NOTE TO TEACHER) 5

APPENDIX A: CONTENT SUMMARY 7

APPENDIX B: INSTRUCTIONAL MATERIALS 10

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

470

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNIT WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATIBLE TO THE LOCAL COMMUNITY.

ECONOMIC ASPECTS OF SWINE PRODUCTION FOR 1974-75

NATIONAL AND STATE SITUATION

THE CORN CROP IS ESTIMATED AT BEING DOWN 12-18% NATIONALLY. THE PRICE FOR CASH CORN IS $3.50 PER BUSHEL. THE CORN CROP REDUCTION WAS DUE TO UNUSUAL WEATHER CONDITION THROUGHOUT THE CORN BELT; TOO WET AT PLANTING, TOO DRY AT POLLINATION AND AN EARLY FROST. LIVE HOG PRICES REMAIN AT LESS THAN $40.00 PER CWT. THESE PRICES ARE LESS THAN 1973.

WITH THE PRICE OF CORN AT ITS PRESENT LEVEL MANY FARMERS WILL BE CONSIDERING THE FOLLOWING ALTERNATIVES FOR THE YEAR:

1. SELL CASH GRAIN.
2. FEED THE CORN TO HOGS AND SELL AT MARKET WEIGHT.
3. FEED THE CORN TO HOGS AND SELL AS FEEDER PIGS.
4. BUY FEEDER PIGS AND SELL AT MARKET WEIGHT.

(NOTE TO TEACHER - THIS UNIT HAS BEEN PREPARED USING OCTOBER 1974 PRICES.)

LOCAL SITUATION

THE TEACHER SHOULD VISIT FARMS OF LOCAL SWINE PRODUCERS TO CONDUCT INTERVIEWS CONCERNING CORN SUPPLY, NUMBER OF HOGS TO BE FED, AND POTENTIAL FOR AN ADEQUATE PROFIT MARGIN.

OBJECTIVES

1. CALCULATE THE BREAK-EVEN PRICE WHEN FEEDING HOGS.
2. COMPARE THE ALTERNATIVES TO DETERMINE WHICH IS MOST PROFITABLE.
3. RECOGNIZE THE ECONOMIC PRINCIPLES APPLICABLE TO PROFITABLE SWINE PRODUCTION.

REFERENCES

BARNES, H. M. "FEEDER PIG FACTS," COOPERATIVE EXTENSION SERVICE, THE OHIO STATE UNIVERSITY, COLUMBUS, OHIO: JUNE, 1964.

BLOSSER, R. H. AND DOSTER, D. H. "COSTS OF PRODUCING HOGS IN OHIO," OARDC, WOOSTER, OHIO, RESEARCH BULLETIN 1001: JULY, 1967.

BUNDY AND DIGGINS. SWINE PRODUCTION. ENGLEWOOD CLIFFS, NEW JERSEY: PRENTICE-HALL, 3RD ED.: 1970.

472

ENSMINGER, M. E. SWINE SCIENCE. DANVILLE, ILLINOIS: THE INTERSTATE PUBLISHERS, 4TH ED.: 1970.

"FARM BUSINESS ANALYSIS REPORT." AGRICULTURAL EDUCATION SERVICE. DIVISION OF VOCATIONAL EDUCATION, OHIO DEPARTMENT OF EDUCATION. COLUMBUS, OHIO: 1973.

"FEEDER PIG PRODUCTION." FARMLAND INDUSTRIES, INC., FARMLAND FOODS, INC.: FEBRUARY, 1974.

"PIG POINTERS," NATIONAL HOG FARMER, SWINE INFORMATION SERVICE, NO. A5 A11, A46.

NEEDED AV EQUIPMENT

CHALKBOARD, WORKSHEET, AND CURRENT PRICES.

ALTERNATIVE INTEREST APPROACHES

ALTERNATIVE A. POSSIBLE QUESTIONS TO STIMULATE INTEREST FOLLOW:

IS FEEDING HOGS REALLY PROFITABLE?

HOW MUCH DOES IT COST TO FEED A MARKET PIG THIS YEAR?

WHAT IS YOUR CORN WORTH WHEN FED TO HOGS?

IS CASH GRAIN FARMING THE MOST PROFITABLE?

IF PORK CHOPS ARE HIGH NOW, HOW MUCH WILL THEY COST NEXT SEPTEMBER 1975?

HOLD DISCUSSION CONCERNING THE ABOVE QUESTIONS.

ALTERNATIVE B. USE HOG CYCLE PROJECTIONS AS A BASIS TO SHOW HOW YEAR TO YEAR CHANGES EFFECT PROFITS.

ALTERNATIVE C. USE FBPA FIGURES TO COMPARE TOTAL COST AND FEED COST OF 1972 AND 1973.

QUESTIONS TO BE ANSWERED

1. WHAT IS THE CURRENT CORN/HOG RATIO?
2. WHAT IS THE MOST PROFITABLE SWINE PRODUCTION OPERATION?
3. WHAT ARE THE DIFFERENT COSTS AND PRODUCTION EFFICIENCY FACTORS BETWEEN CONCENTRATE AND PELLETED RATIONS?

473

LEARNING ACTIVITIES

1. WHAT IS THE CURRENT CORN/HOG RATIO?

(SEE PAGE 11 OF CONTENT SUMMARY FOR EXPLANATION ON FIGURING CORN/HOG RATIO.)

2. WHAT IS THE MOST PROFITABLE SWINE PRODUCTION OPERATION?

DISCUSS TRANSPARENCIES #1-2 AND WORK SAMPLE PROBLEM TO FAMILIARIZE CLASS MEMBERS WITH CALCULATING PRODUCTION COSTS OF THE THREE ALTERNATIVES:

- BREEDING TO MARKET
- BREEDING TO FEEDER PIG
- FEEDER PIG TO MARKET

USE HANDOUTS #1-3 TO DETERMINE INDIVIDUAL PRODUCTION COSTS FOR THE THREE ALTERNATIVES.

3. WHAT ARE THE DIFFERENT COSTS AND PRODUCTION EFFICIENCY FACTORS BETWEEN CONCENTRATE AND PELLETED RATIONS?

DISCUSS TRANSPARENCIES #3-8 AND WORK A SAMPLE PROBLEM TO FAMILIARIZE CLASS MEMBERS WITH THE PROCEDURES USED TO CALCULATE COMPARABLE RATION COSTS.

- PREBREEDING TO MARKET
- PREBREEDING TO FEEDER PIG
- FEEDER PIG TO MARKET

UTILIZE HANDOUTS #4-6 TO DETERMINE EFFICIENCY FACTORS AND INDIVIDUAL RATION COSTS.

TO SUMMARIZE (NOTE TO TEACHER)

1. THE MAXIMUM ECONOMIC RETURNS AT OCTOBER 1974 PRICES RESULTED IF THE CORN WAS SOLD AS CASH GRAIN.
2. SOME FARMERS WILL CONTINUE TO FEED HOGS BECAUSE:
    A. THE VALUE OF THE FED CORN IS GREATER THAN HIS CORN PRODUCTION COSTS.
    B. THE INVESTMENT IN BUILDINGS, EQUIPMENT AND BREEDING STOCK ARE LARGE ENOUGH THEY MUST BE KEPT IN USE.
    C. THE OUTLOOK IS THAT FEWER HOGS WILL BE PRODUCED AND FED, THUS THE PRICE OF PORK SHOULD RISE.

2. REVIEW THE PROCEDURE TO USE TO COMPARE ALTERNATIVES TO DETERMINE WHICH MIGHT BE THE MOST PROFITABLE.

3. DISCUSS THE ECONOMIC PRINCIPLES APPLICABLE TO PROFITABLE SWINE PRODUCTION.

APPENDIX A

CONTENT SUMMARY

ECONOMIC ASPECTS OF SWINE PRODUCTION FOR 1974-75

A number of commercial feed companies have worksheets (Landmark, Moormans) or booklets (Master Mix, Purina, Wayne) they use with customers to estimate feed consumption and costs. These with their current prices can be utilized as a teaching aid. Most companies will give the sheets or booklets to you.

Most swine production books or "Preparing Budgets" may be used to identify figures on feed consumption and efficiency.

Current prices can be secured from local elevator, newspaper or radio broadcast market information.

The problem currently (October, 1974) is: The price of cash corn is higher ($3.50 compared to $1.05) than in recent years but the price of market hogs is down ($38.50 compared to $44.00 last year).

A profitable corn-hog ratio is 13:1. The ratio is the number of bushels of corn 100# of pork will buy. Cuprently this ratio is:

$$\begin{array}{r} 11 \\ 3\underset{\smile}{.50}\,\overline{\smash{)}\,38\underset{\smile}{.50}} \end{array}$$

11:1. In this example a 11:1 ratio is not profitable.

The value of a bushel of corn fed to hogs can be computed after all costs have been computed and figured. Then substract the value of the supplement and non-feed costs from the value of one market pig. This answer is divided by the number of bushels needed to produce the hog. The resulting answer is the value of one bushel of corn when fed to a market pig.

$80.85	Value of 1 pig 210# @ $38.50
51.91	Value of supp. $28.67 & $23.24 non-feed costs
$28.94	Returns from corn

$$\begin{array}{rl} \$2.83 & \text{Value of 1 bu. of corn fed} \\ \text{Bushels of corn required } 10.25\,\overline{\smash{)}\,\$28.94} & \text{Returns from corn} \end{array}$$

This value of $2.83 for corn fed to hogs can be compared to $3.50 for cash corn.

Farm Business Analysis Reports of Vo-Ag teachers show:

COMPARING FEED COSTS AND TOTAL COSTS 1972-1973

FEEDER PIGS	1972	1973
TOTAL COST/CWT PORK	$18.91	$31.88
FEED COST/CWT PORK	$12.30	$23.70
POUND FEED/1# PORK	3.84#	4.08#
RETURNS FOR UNPD. LABOR	$ 8.76	$ 5.52
SWINE BREEDING		
TOTAL COST/CWT PORK	$26.38	$43.48
FEED COST/CWT PORK	$15.30	$25.50
POUNDS FEED/1# PORK	3.90#	4.32#
RETURNS FOR UNPD. LABOR	$ 7.99	$ 8.57

THERE WAS A SIZEABLE INCREASE IN THE FEED COST PER 100# PRODUCED IN 1973.

EXTREME VARIATIONS IN THE CORN-HOG RATIO OCCURRED IN 1973.

APPENDIX B

INSTRUCTIONAL MATERIALS

HANDOUTS

H-1: PRINCIPLES

H-2: STANDARD BUDGET FOR SWINE

H-3: WORKSHEET (PRODUCTION COSTS)

H-4: LANDMARK WORKSHEET FEED COST (GRIND & MIX)

H-5: LANDMARK WORKSHEET FEED COST (PELLETS)

H-6: MOORMAN WORKSHEET FEED COST (BIRTH TO MARKET)

TRANSPARENCIES

T-1: WORKSHEET (PRODUCTION COSTS)

T-2: WORKSHEET (DETERMINING PRODUCTION COST)

T-3: FEED COST (GRIND & MIX)

T-4: FEED COST (BREEDING)

T-5: FEED COST (PER 100# OF PORK)

T-6: LANDMARK WORKSHEET (PELLETS)

T-7: LANDMARK WORKSHEET (TOTAL COST/CWT)

T-8: MOORMAN WORKSHEET (ESTIMATED FEED COST)

PRINCIPLES

(To be used with worksheets.)

1. To produce 100# of pork from breeding to market
    a. It requires 10¼ bushels of corn
    b. It requires 238# supplement.

2. To produce one feeder pig (breeding to 60#)
    a. It requires 2 bushels of corn
    b. It requires 80# supplement.

3. To produce 150# of gain from 60# feeder pig to 210# market weight
    a. It requires 8¼ bushels of corn
    b. It requires 158# supplement.

4. Corn is priced at $3.50 per bushel, hogs sell for $38.50 per cwt, feeder pigs sell for $20.00 per head.

5. The commercial supplement sells for $12.05 per cwt. (averages)

6. The non-feed costs per 100# pork is $11.62.

7. A profitable corn-hog ratio should be in excess of 13:1.

8. A bushel of corn fed to market hogs will return the feeder $7.83.

9. A charge of 50¢ in price of market hogs will change the vlaue of a bushel of corn fed by 10¢ in direct proportion.

STANDARD BUDGET FOR SWINE

	Bushels Corn (56#/bu.) Equivalent	Lbs. Supplement	Tons Corn Silage	Tons Hay	Pasture Tons, Hay Equivalent	Hours of Labor
			# Creep Feed			
Sow and 2 litters, 14 pigs to market	150	1800	392	.2	.2	34
3 pigs to market	10.7	135	28	-	-	2.4
14 feeder pigs, 60 lbs.	42	602	392	.2	.2	16
1 feeder pig, 60 lbs.	3	43	28	-	-	1.1
Hog feeding, buy 60# pig, 3-5 months	8	85	-	-	-	1.3

WORKSHEET

Given: Corn $3.50/Bu.; Mkt. hogs $38.50/cwt
Feeder Pigs $20.00/head, Non-feed costs $11.62/cwt

Requirements for 1 Pig (From Feeder Pig Facts, H. M. Barnes)

Sow:	2 bu. corn	$ 7.00	
	50# supp. @ $11.00	5.50	$12.50
Pig: birth to 60#			
	30# creep-feed @ $15.50	$ 4.65	$ 4.65
Pig: 60# to 120#			
	3¼ Bu. corn	$11.38	
	49# Supp. @ $12.65	6.20	$17.58
Pig: 120 to 210#			
	5 Bu. corn	$17.50	
	109# Supp. @ $11.30	12.32	$29.82

Show your work:

A. Determine total cost of production for 1 market hog (Breeding to Market).

	$30.74	Feed cost
	11.62	Non-feed
Income $38.50	$42.36	Total costs per cwt
Loss $ 3.66		

B. Determine total cost of production for 1 feeder pig (Breeding to 60#).

	$17.15	Feed costs
	5.00	Non-feed costs (est.)
Income $20.00	$22.15	Total costs per pig
Loss $ 2.15		

C. Determine total cost of buying 1 feeder pig and feeding to market weight (210#).

	$26.34	Feed costs
	8.00	Non-feed costs
	10.00	Feeder pig cost
Income $38.50	$44.34	Total cost per cwt
Loss $ 5.84		

D. Which of the above is the most profitable?

E. Which is the most profitable for a farmer answer D or sell cash corn? Why?

WORKSHEET

Given:

Requirements for 1 Pig

Sow:

Pig: birth to 60#

Pig: 60# to 120#

Pig: 120# to 210#

Show your work:

A. Determine total cost of production for 1 market hog (Breeding to Market).

B. Determine total cost of production for 1 feeder pig (Breeding to 60#).

C. Determine total cost of buying 1 feeder pig and feeding to market weight (210#).

D. Which of the above is the most profitable?

E. Which is the most profitable for a farmer answer D or sell cash corn? Why?

484

(Landmark Worksheet)

Prices: Landmark Clinton County
Oct. 1974

Feed Cost for 1 Sow and Litter - Pre-breeding to Market - GRIND & MIX

SOW

A. 20 days pre-breeding -

Ration:			
1400#	Shelled Corn	$.0625	$87.50
400#	Sow & Pig	$11.00	$44.00
200#	Alfalfa Meal	$ 7.60	$15.20

7# daily, 20 days = 140# $10.28

B. Gestation -

Ration:
1400# Shelled Corn
400# Sow & Pig
200# Alfalfa Meal

First 80 days, 4# daily, 80 days = 320# $23.49

C. 80 Days to Farrowing -

Ration: Same as above

35 days, 6# daily = 210# $15.42

D. Lactation -

Ration:			
1200#	Shelled Corn	$.0625	$75.00
400#	Sow & Pig	$11.00	$44.00
200#	Alfalfa Meal	$ 7.60	$15.20
200#	Oats or Mids	$ 1.35/bu	$11.22

42 days, 10# daily = 420# $30.58

Total pounds and cost of Sow Feed - 1,090# $79.77

PIGS

Feed to cover sow cost - 8 weaned = 136#			$ 9.77
7-28 days Pig Aid	= 5#	$16.30	$ .82
28 days - 40# Pig Maker	= 25#	$10.30	$ 2.58
40 - 125#	= 255#		$20.25

Ration: 1450# Sh. Corn or 500# Sh. Corn $.0625 or 1550# Sh. Corn
550# Sow & Pig 500# Pig Supp.$13.00 450# Pork Maker

= 340# $22.99

125# - 210#

Ration: 1700# Sh. Corn or 1700# Sh. Corn or 750# Sh. Corn $.062
300# Sow & Pig   300# Pig Supp.   250# Pork Maker$10.3

Total pounds feed and cost of feed per pig - 761# $56.61

Feed conversion - ______

Feed cost per 100# of pork - $26.96

Non-feed cost per cwt. - $11.62

$38.58

1/73
Stavrook/red

Feed Cost for 1 Sow and Litter - Pre-breeding to Market - GRIND & MIX

SOW

A. 20 days pre-breeding -

Ration:

____

B. Gestation -

Ration:

____

C. 80 Days to Farrowing -

Ration:

____

D. Lactation -

Ration:

____

PIGS

Feed to cover sow cost - 8 weaned = 136# ________

7-28 days Pig Aid = 5# ________

28 days - 40# Pig Maker = 25# ________

40 - 125# = 255# ________

Ration:

= 340# ________

125# - 210#

Ration:

Total pounds feed and cost of feed per pig - 761# ________

Feed conversion - ________

Feed cost per 100# of pork - ________

Non-feed cost per cwt. - ________

____

(Landmark Worksheet)

Prices from Landmark Clinton
Co. Oct. 1974

Feed Cost for 1 Sow and Litter - Pre-Breeding to Market - PELLETS ALL THE WAY

SOW

20 Days Pre-breeding -		
$9.20	3# Sow Chunx, 20 days = 60#	$ 5.52
.0625	4# Shelled Corn, 20 days = 80#	5.00
First 80 days of gestation -		
	3# Sow Chunx, 80 days = 240#	22.08
80 days - 100 days gestation -		
	3# Sow Chunx, 20 days = 60#	5.52
	2# Shelled Corn, 20 days = 40#	2.50
100 days to farrowing -		
$9.60	6# Medi-Pels, 15 days = 90#	8.64
14 days past farrowing -		
	8# Medi-Pels, 14 days = 112#	10.76
28 days lactation -		
$8.70	10# Pig Developer, 28 days = 280#	24.36
	Total pounds and cost of sow feed - 962#	$84.38

Sow feed cost per pig: 10 weaned, ______
8 weaned, $10.55
6 weaned, ______

PIGS

(8 weaned)

Feed to cover sow feed cost		120# =	$10.55
7-28 days, Pig Aid	$16.30	5# =	.82
4 Weeks - 40#, Pig Maker	$10.30	25# =	2.58
40# - 125#, Pig Developer		220# =	19.14
125# - 210#, Pork Maker 13	$8.70	300# =	26.10

Total pounds of feed and cost of feed per pig - 670#	$59.19
Cost per 100# of pork	$28.19
Feed conversion	$ 3.29
Non-feed Costs	$11.62
Total Cost/Cwt.	$39.81

1/73
Stayrook/red

(Landmark Worksheet)

Feed Cost for 1 Sow and Litter - Pre-breeding to Market - PELLETS ALL THE WAY

SOW

20 Days Pre-breeding -
3# Sow Chunx, 20 days = 60# ________
4# Shelled Corn, 20 days = 80# ________

First 80 days of gestation -
3# Sow Chunx, 80 days = 240# ________

80 days - 100 days gestation -
3# Sow Chunx, 20 days = 60# ________
2# Shelled Corn, 20 days = 40# ________

100 days to farrowing -
6# Medi-Pels, 15 days = 90# ________

14 days past farrowing -
8# Medi-Pels, 14 days = 112# ________

28 days lactation -
10# Pig Developer, 28 days =280# ________

Total pounds and cost of sow feed - 962# ________

Sow feed cost per pig: 10 weaned, ________
8 weaned, ________
6 weaned, ________

PIGS

(8 weaned)
Feed to cover sow feed cost 120# = ________

7-28 days, Pig Aid 5# = ________

4 weeks - 40#, Pig Maker 25# = ________

40# - 125#, Pig Developer 220# = ________

125# - 210#, Pork Maker 13 300# = ________

Total pounds of feed and cost of feed per pig - 670# ________

Cost per 100# of pork ________

Feed conversion ________

Non-feed Costs ________

Total Cost/Cwt. ________

490

1/73
Stayrook/red

ESTIMATED FEED COST

BIRTH TO MARKET

10# Pig Starter	@ $20.10	$ 2.01
42# Pig Mintrate	@ $17.36	$ 7.30
28# Mintrate 45 for Hogs	@ $16.20	$ 4.54
	Totals	$13.85
9 bu. Grain	@ $ 3.50 per bu.	$31.50
ESTIMATED TOTAL FEED COST PER MARKET HOG		$45.35***
	Sow feed for 1 Pig	8.00
		$53.35

$53.35 = $25.40 per cwt pork produced

$25.40	Feed Cost
11.62	Non-feed Cost
$37.02	Total cost per cwt.

***Not including cost of pig or value of sows milk

Moorman Worksheet

ESTIMATED FEED COST
BIRTH TO MARKET

10# Pig Starter ________

42# Pig Mintrate ________

78# Mintrate 45 for Hogs ________

Totals ________

9 bu. Grain ________

ESTIMATED TOTAL FEED COST PER MARKET HOG ________***

***Not including cost of pig or value of sows milk

WORKSHEET

Given: Corn $3.50/Bu.; Mkt. hogs $38.50/cwt

Feeder Pigs $20.00/head, Non-feed costs $11.62/cwt

Requirements for 1 Pig (From Feeder Pig Facts, H. M. Barnes)

Sow:	2 bu. corn	$7.00	
	50# supp. @ $11.00	5.50	$12.50
Pig: birth to 60#			
	30# creep-feed @ $15.50	$4.65	$ 4.65
Pig: 60# to 120#			
	3 1/4 Bu. corn	$11.38	
	49# Supp. @ $12.65	6.20	$17.58
Pig: 120# to 210#			
	5 Bu. corn	$17.50	
	109# Supp. @ $11.30	12.32	$29.82

WORKSHEET

GIVEN:

REQUIREMENTS FOR 1 PIG

SOW:

PIG: BIRTH TO 60#

PIG: 60# TO 120#

PIG: 120# TO 210#

494

WORKSHEET

SHOW YOUR WORK:

A. DETERMINE TOTAL COST OF PRODUCTION FOR 1 MARKET HOG (BREEDING TO MARKET).

$30.74	FEED COST
11.62	NON-FEED
$42.36	TOTAL COSTS PER CWT

INCOME $38.50
LOSS $ 3.66

B. DETERMINE TOTAL COST OF PRODUCTION FOR 1 FEEDER PIG (BREEDING TO 60#).

$17.15	FEED COSTS
5.00	NON-FEED COSTS (EST.)
$22.15	TOTAL COSTS PER PIG

INCOME $20.00
LOSS $ 2.15

C. DETERMINE TOTAL COST OF BUYING 1 FEEDER PIG AND FEEDING TO MARKET WEIGHT (210#).

$26.34	FEED COSTS
8.00	NON-FEED COSTS
10.00	FEEDER PIG COST
$44.34	TOTAL COST PER CWT

INCOME $38.50
LOSS $ 5.84

D. WHICH OF THE ABOVE IS THE MOST PROFITABLE?

E. WHICH IS THE MOST PROFITABLE FOR A FARMER ANSWER D OR SELL CASH CORN? WHY?

WORKSHEET

SHOW YOUR WORK:

A. DETERMINE TOTAL COST OF PRODUCTION FOR 1 MARKET HOG (BREEDING TO MARKET).

B. DETERMINE TOTAL COST OF PRODUCTION FOR 1 FEEDER PIG (BREEDING TO 60#).

C. DETERMINE TOTAL COST OF BUYING 1 FEEDER PIG AND FEEDING TO MARKET WEIGHT (210#).

D. WHICH OF THE ABOVE IS THE MOST PROFITABLE?

E. WHICH IS THE MOST PROFITABLE FOR A FARMER ANSWER D OR SELL CASH CORN? WHY?

T-2A

(Landmark Worksheet)
Prices: Landmark Clinton County
Oct. 1974

Feed Cost for 1 Sow and Litter - Pre-breeding to Market - GRIND & MIX

SOW

A. 20 days pre-breeding -

Ration:	1400# Shelled Corn	$.0625	$87.50
	400# Sow & Pig	$11.00	$44.00
	200# Alfalfa Meal	$ 7.60	$15.20

7# daily, 20 days = 140# $10.28

B. Gestation -

Ration: 1400# Shelled Corn
400# Sow & Pig
200# Alfalfa Meal

First 80 days, 4# daily, 80 days = 320#
$23.49

(LANDMARK WORKSHEET)

FEED COST FOR 1 SOW AND LITTER - PRE-BREEDING TO MARKET - GRIND & MIX

SOW

A. 20 DAYS PRE-BREEDING -

RATION: 1400# SHELLED CORN
400# SOW & PIG
200# ALFALFA MEAL
7# DAILY, 20 DAYS = 140# ________

B. GESTATION -

RATION: 1400# SHELLED CORN
400# SOW & PIG
200# ALFALFA MEAL
FIRST 80 DAYS, 4# DAILY, 80 DAYS = 320#

____

SOW

C. 80 DAYS TO FARROWING -

RATION: 1400# SHELLED CORN

400# SOW & PIG

200# ALFALFA MEAL

35 DAYS, 6# DAILY = 210# $15.42

D. LACTATION -

RATION:	1200# SHELLED CORN	$.0625	$75.00
	400# SOW & PIG	$11.00	$44.00
	200# ALFALFA MEAL	$ 7.60	$15.20
	200# OATS OR MIDS	$ 1.85/BU	$11.22

42 DAYS, 10# DAILY = 420# $30.58

TOTAL POUNDS AND COST OF SOW FEED - 1,090# $79.77

. SOW

C. 80 days to Farrowing -

Ration: 1400# Shelled Corn
400# Sow & Pig
200# Alfalfa Meal

35 days, 6# daily = 210# ________

D. Lactation -

Ration: 1200# Shelled Corn
400# Sow & Pig
200# Alfalfa Meal
200# Oats or Mids

42 days, 10# daily = 420# ________

Total pounds and cost of Sow Feed - 1,090# ________

PIGS

FEED TO COVER SOW COST - 8 WEANED = 136#			$ 9.77
7-28 DAYS PIG AID	= 5#	$16.30	$ .82
28 DAYS - 40# PIG MAKER	= 25#	$10.30	$ 2.58
40 - 125#	= 255#		$20.25

RATION: 1450# SH. CORN
550# SOW & PIG
OR
500# SH. CORN $.0625
500# PIG SUPP. $13.00
OR
1550# SH. CORN
450# PORK MAKER

= 340# $22.99

125 - 210# -

RATION: 1700# SH. CORN
300# SOW & PIG
OR
1700# SH. CORN
300# PIG SUPP.
OR
750# SH. CORN $.0625
250# PORK MAKER $10.30

TOTAL POUNDS FEED AND COST OF FEED PER PIG - 761# $56.61

FEED CONVERSION - ______

FEED COST PER 100# OF PORK - $26.96

NON-FEED COST PER CWT. - $11.62

$38.58

PIGS

FEED TO COVER SOW COST - 8 WEANED = 136# ________

7-28 DAYS PIG AID = 5# ________

28 DAYS - 40# PIG MAKER = 25# ________

40 - 125# = 255# ________

RATION: 1450# SH. CORN OR 500# SH. CORN OR 1550# SH. CORN
550# SOW & PIG 500# PIG SUPP. 450# PORK MAKER
= 340# ________

125 - 210#

RATION: 1700# SH. CORN OR 1700# SH. CORN OR 750# SH. CORN
300# SOW & PIG 300# PIG SUPP. 250# PORK MAKER

TOTAL POUNDS FEED AND COST OF FEED PER PIG - 761# ________

FEED CONVERSION - ________

FEED COST PER 100# OF PORK - ________

NON-FEED COST PER CWT. - ________

____

T-5A

(Landmark Worksheet)

Prices from Landmark Clinton Co.

Oct. 1974

Feed Cost for 1 Sow and Litter - Pre-Breeding to Market - PELLETS ALL THE WAY

SOW

20 Days Pre-breeding -			
	$9.20	3# Sow Chunx, 20 days = 60#	$ 5.52
	.0625	4# Shelled Corn, 20 days = 80#	5.00
First 80 days of gestation -			
		3# Sow Chunx, 80 days = 240#	22.08
80 days - 100 days gestation -			
		3# Sow Chunx, 20 days = 60#	5.52
		2# Shelled Corn, 20 days = 40#	2.50
100 days to farrowing -			
	$9.60	6# Medi-Pels, 15 days = 90#	8.64
14 days past farrowing -			
		8# Medi-Pels, 14 days = 112#	10.76
28 days lactation -			
	$8.70	10# Pig Developer, 28 days = 280#	24.36
		Total pounds and cost of sow feed - 962#	$84.38

Sow feed cost per pig: 10 weaned, ________

8 weaned, ________

6 weaned, ________

(LANDMARK WORKSHEET)

FEED COST FOR 1 SOW AND LITTER - PRE-BREEDING TO MARKET - PELLETS ALL THE WAY

SOW

20 DAYS PRE-BREEDING -

3# SOW CHUNX, 20 DAYS = 60# ______

4# SHELLED CORN, 20 DAYS = 80# ______

FIRST 80 DAYS OF GESTATION -

3# SOW CHUNX, 80 DAYS = 240# ______

80 DAYS - 100 DAYS GESTATION -

3# SOW CHUNX, 20 DAYS = 60# ______

2# SHELLED CORN, 20 DAYS = 40# ______

100 DAYS TO FARROWING -

6# MEDI-PELS, 15 DAYS = 90# ______

14 DAYS PAST FARROWING -

8# MEDI-PELS, 14 DAYS = 112# ______

28 DAYS LACTATION - 10# PIG DEVELOPER, 28 DAYS = 280# ______

TOTAL POUNDS AND COST OF SOW FEED - 962# ______

SOW FEED COST PER PIG: 10 WEANED, ______
8 WEANED, ______
6 WEANED, ______

T-6A

PIGS

(8 WEANED)

FEED TO COVER SOW FEED COST		120#	= $10.55
7-28 DAYS, PIG AID	$16.30	5#	= .82
4 WEEKS - 40#, PIG MAKER	$10.30	25#	= 2.58
40# - 125#, PIG DEVELOPER		220#	= 19.14
125# - 210#, PORK MAKER 13	$8.70	300#	= 26.10

TOTAL POUNDS OF FEED AND COST OF FEED PER PIG - 670#	$59.19
COST PER 100# OF PORK	$28.19
FEED CONVERSION	$ 3.29
NON-FEED COSTS	$11.62
TOTAL COST/CWT.	$39.81

(LANDMARK WORKSHEET)

PIGS

(8 WEANED)

FEED TO COVER SOW FEED COST 120# = ______

7-28 DAYS, PIG AID 5# = ______

4 WEEKS - 40#, PIG MAKER 25# = ______

40# - 125#, PIG DEVELOPER 220# = ______

125# - 210#, PORK MAKER 13 300# = ______

TOTAL POUNDS OF FEED AND COST OF FEED PER PIG - 670# ______

COST PER 100# OF PORK ______

FEED CONVERSION ______

NON-FEED COSTS ______

TOTAL COST/CWT. ______

Moorman Worksheet

ESTIMATED FEED COST
BIRTH TO MARKET

10# Pig Starter	@ $20.10	$ 2.01
42# Pig Mintrate	@ $17.36	$ 7.30
28# Mintrate 45 for Hogs	@ $16.20	$ 4.54
	Totals	$13.85
9 bu. Grain	@ $ 3.50 per bu.	$31.50
ESTIMATED TOTAL FEED COST PER MARKET HOG		$45.35***
	Sow feed for 1 Pig	8.00
		$53.35

$53.35 = $25.40 per cwt pork produced

$25.40	Feed cost
11.62	Non-feed cost
$37.02	Total cost per cwt.

***Not including cost of pig or value of sows milk

Moorman Worksheet

ESTIMATED FEED COST
BIRTH TO MARKET

10# Pig Starter ________

42# Pig Mintrate ________

28# Mintrate 45 for Hogs ________

Totals ________

9 Bu. Grain ________

ESTIMATED TOTAL FEED COST PER MARKET HOG ________***

***Not including cost of pig or value of sows milk

ADULT UNITS NO. 16, 17, 18

WHAT CAN YOU AFFORD TO PAY FOR LAND

A SERIES OF RESOURCE UNITS FOR ADULT EDUCATION
CLASSES IN AGRICULTURE

DEVELOPED BY
THOMAS KREMER

EDITED BY
J. DAVID MCCRACKEN

DEPARTMENT OF AGRICULTURAL EDUCATION
COLLEGE OF AGRICULTURE AND HOME ECONOMICS
THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO 43210

1975

509

PREFACE

THIS RESOURCE UNIT WAS DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U. S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN
ASSISTANT PROFESSOR

L. H. NEWCOMB
ASSISTANT PROFESSOR

TABLE OF CONTENTS

	PAGE
PREFACE	III
INTRODUCTION	1
STATE SITUATION	3
LOCAL SITUATION (NOTE TO TEACHER)	3
OBJECTIVES	3
REFERENCES	3
NEEDED AV EQUIPMENT	4
ALTERNATIVE INTEREST APPROACHES	4
UNIT 14 - FARM GOALS AND NET WORTH	5
UNIT 15 - CAPITAL DEMANDS AND REPAYMENT CAPABILITIES	5
UNIT 16 - INTEREST, REPAYMENT TERMS AND PARTIAL BUDGETS	6
TO SUMMARIZE (NOTE TO TEACHER)	7
APPENDIX A: CONTENT SUMMARY	8
APPENDIX B: INSTRUCTIONAL MATERIALS	13

511

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATABLE TO THE LOCAL COMMUNITY.

WHAT CAN YOU AFFORD TO PAY FOR LAND

STATE SITUATION

AVERAGE FARM REAL ESTATE VALUES IN OHIO HAVE INCREASED FROM $399/ ACRE IN 1970 TO $636 IN 1974. AN INCREASE OF 37 PERCENT OVER A FIVE YEAR PERIOD. THE 1972 VALUE PER ACRE WAS $438 COMPARED TO A 1973 VALUE PER ACRE OF $507. THIS AMOUNTS TO A 14 PERCENT INCREASE IN LAND VALUE PER ACRE.

THE FARMS PARTICIPATING IN THE FARM BUSINESS ANALYSIS PROGRAM HAD AN AVERAGE NET INCOME OF $21,553 IN 1972. THE 1973 AVERAGE NET INCOME WAS $28,456, A 21 PERCENT INCREASE.

LOCAL SITUATION (NOTE TO TEACHER)

IDENTIFY A FEW LOCAL FARMS IN YOUR AREA THAT HAVE BEEN SOLD RECENTLY. VISIT THE COUNTY COURTHOUSE TO OBTAIN SELLING PRICE AND TOTAL ACREAGE FROM THE LAND DEED. CONTACT A LOCAL AGRICULTURAL LAND APPRAISER TO ESTABLISH LAND MARKET VALUES. THE LOCAL EXTENSION AGENT, AREA FARM MANAGEMENT SPECIALIST, AND LOCAL FBPA INSTRUCTOR WILL BE ABLE TO PROVIDE THE LOCAL AVERAGE FARM NET INCOME.

OBJECTIVES

THE LEARNER IS TO:

UNIT 14

1. DETERMINE INDIVIDUAL FARM FAMILY GOALS.

2. PREPARE NET WORTH STATEMENTS.

UNIT 15

3. DEVELOP CASH FLOW SCHEDULES.

4. DEVELOP INDIVIDUAL FINANCIAL STATEMENTS.

UNIT 16

5. INVESTIGATE THE COST OF LONG-TERM CREDIT.

6. DETERMINE HOW MUCH ONE CAN AFFORD TO PAY FOR FARM REAL ESTATE (UTILIZE PARTIAL BUDGETS).

REFERENCES

FARM CREDIT BANKS. CREDIT IN AGRICULTURE.

STATE DEPARTMENT OF EDUCATION, AND THE OHIO STATE UNIVERSITY. _TEACHERS GUIDE TO FARM MONEY MANAGEMENT_. COLUMBUS, OHIO: AGRICULTURAL EDUCATION SERVICE, STATE DEPARTMENT OF EDUCATION, AND DEPARTMENT OF AGRICULTURAL EDUCATION, THE OHIO STATE UNIVERSITY, 19__.

THE OHIO STATE UNIVERSITY. _OHIO FARM MANAGEMENT HANDBOOK_. COLUMBUS, OHIO: DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY, 19__.

THE OHIO STATE UNIVERSITY. _FARM BUSINESS PLANNING AND ANALYSIS TEACHING UNITS_. COLUMBUS, OHIO: AGRICULTURAL EDUCATION DEPARTMENT AND OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, 19__.

NEEDED AV EQUIPMENT

OVERHEAD PROJECTOR, SCREEN PROJECTOR, CHALKBOARD, AND CALCULATOR.

ALTERNATIVE INTEREST APPROACHES

ALTERNATIVE A. DETERMINE THE LONG-RANGE FAMILY GOALS OF A CLASS MEMBER. DEVELOP A CHALKBOARD CHART SHOWING CURRENT AND FUTURE EXPANSION PLANS. CONSIDER THE YOUNGER FAMILY MEMBERS AND HOW THEIR PARTICIPATION (OR NON-PARTICIPATION) WILL AFFECT LONG-RANGE GOALS.

ALTERNATIVE B. OBTAIN AS MANY DETAILS AS POSSIBLE ABOUT 2 OR 3 FARM REAL ESTATE TRANSACTIONS IN YOUR AREA. PLACE CLASS MEMBERS IN THE ROLE OF BUYER FOR EACH CASE. HAVE THEM CONSIDER THE SPECIFIC COSTS INVOLVED IN EACH TRANSACTION, AND DISCUSS ALTERNATIVE REPAYMENT PROSPECTS

ALTERNATIVE C. DETERMINE CURRENT INTEREST RATES AND CONSIDER PREDICTED CHANGES. DISCUSS HOW THIS AFFECTS LAND BUYING NOW. DEVELOP A CHALKBOARD CHART TO SHOW CURRENT INTEREST RATES ON LOANS IN YOUR AREA.

(CHALKBOARD CHART)

	CURRENT INTEREST RATE %	ANTICIPATED INTEREST RATE %
LOCAL BANKS		
____________		
____________		
____________		
LOCAL SAVINGS & LOAN ASSOC.		
____________		
____________		
OTHER		
____________		

UNIT 14 - FARM GOALS AND NET WORTH

QUESTIONS TO BE ANSWERED

1. WHAT ARE YOUR INDIVIDUAL FARM FAMILY GOALS?

    A. WHAT ARE YOUR CURRENT AND FUTURE EXPANSION PLANS?

    B. DO YOU PLAN ON BRINGING YOUNGER MEMBERS OF THE FAMILY INTO THE FARM BUSINESS?

    C. DO YOU ASPIRE TO CONTROL LAND THROUGH OWNERSHIP?

2. WHAT IS THE FINANCIAL WORTH OF YOUR FARM BUSINESS? OF WHAT VALUE IS A COMPLETE AND ACCURATE NET WORTH STATEMENT?

LEARNING ACTIVITIES

1. WHAT ARE YOUR INDIVIDUAL FARM-FAMILY GOALS?

THE TEACHER SHOULD UTILIZE THE BLACKBOARD TO LIST LONG-RANGE FAMILY GOALS OF A CLASS MEMBER.

DIRECT DISCUSSION AROUND FARM EXPANSION AND INCLUSION OF FAMILY MEMBERS INTO THE FARM OPERATION.

2. WHAT IS THE FINANCIAL WORTH OF YOUR FARM BUSINESS? OF WHAT VALUE IS A COMPLETE AND ACCURATE NET WORTH STATEMENT?

SHOW TRANSPARENCIES #1-12 AND DISTRIBUTE HANDOUTS #1 AND 2: "ANALYSIS OF THE NET WORTH STATEMENT."

DISCUSS THE FINANCIAL STATUS OF THIS SAMPLE ENTERPRISE AND THEN ASSIST CLASS PARTICIPANTS IN DETERMINING HOW THEY WOULD PREPARE THEIR OWN NET WORTH STATEMENTS.

PREPARE NET WORTH STATEMENTS.

UNIT 15 - CAPITAL DEMANDS AND REPAYMENT CAPABILITIES

QUESTIONS TO BE ANSWERED

3. WHAT ARE YOUR CAPITAL DEMANDS THROUGHOUT THE YEAR? WHAT, IF ANY, WILL BE YOUR SURPLUS SITUATION? WOULD ADDITIONAL CAPITAL FOR EXPANSION IMPROVE THE INCOME SIDE OF YOUR CASH FLOW?

4. WHAT ARE YOUR DEBT REPAYMENT CAPABILITIES?

LEARNING ACTIVITIES

3. WHAT ARE YOUR CAPITAL DEMANDS THROUGHOUT THE YEAR? WHAT, IF ANY, WILL BE YOUR SURPLUS SITUATION? WOULD ADDITIONAL CAPITAL FOR EXPANSION IMPROVE THE INCOME SIDE OF YOUR CASH FLOW?

DISCUSS TRANSPARENCIES #13-20. DISTRIBUTE HANDOUTS #3-6: "FARM AND FAMILY FINANCIAL BUDGET." HELP FARMER PARTICIPANTS TO UNDERSTAND HOW TO DEVELOP THEIR OWN CASH FLOWS.

DEVELOP A CASH FLOW SCHEDULE.

4. WHAT ARE YOUR DEBT REPAYMENT CAPABILITIES?

DISCUSS TRANSPARENCIES #21-24. DISTRIBUTE HANDOUTS #7 AND 8: "BALANCE SHEET," AND "LIABILITIES AND NET WORTH."

HELP FARMER PARTICIPANTS TO FULLY UNDERSTAND EACH CATEGORY ON THE TWO WORKSHEETS.

DEVELOP INDIVIDUAL FINANCIAL STATEMENT.

UNIT 16 - INTEREST, REPAYMENT TERMS AND PARTIAL BUDGETS

QUESTIONS TO BE ANSWERED

5. WHAT METHOD OF CHARGING INTEREST CAN YOU SECURE? WHAT SECURITIES CAN YOU OFFER? WHAT REPAYMENT TERMS CAN BE SECURED?

6. ON THE BASIS OF A PARTIAL BUDGET, WHAT INCREASES CAN BE EXPECTED IN NET FARM RETURNS? WILL THE FARM BUSINESS PROSPER WITH THE ADDITIONAL CAPITAL DRAIN FOR DEBT REPAYMENT?

LEARNING ACTIVITIES

5. WHAT METHOD OF CHARGING INTEREST CAN YOU SECURE? WHAT SECURITIES CAN YOU OFFER? WHAT REPAYMENT TERMS CAN BE SECURED?

DEMONSTRATE INTEREST CALCULATIONS AT VARIOUS RATES AND VALUES (PRINCIPLES) ON THE CHALKBOARD. SHOW TRANSPARENCIES #25 AND 26 AND USE HANDOUT #9.

INVESTIGATE THE COST OF LONG-TERM CREDIT.

6. ON THE BASIS OF A PARTIAL BUDGET, WHAT INCREASES CAN BE EXPECTED IN NET FARM RETURNS? WILL THE FARM BUSINESS PROSPER WITH THE ADDITIONAL CAPITAL DRAIN FOR DEBT REPAYMENT?

DISCUSS TRANSPARENCY #27 TO DEVELOP AN UNDERSTANDING OF HOW TO PREPARE A PARTIAL BUDGET.

WORK WITH TRANSPARENCIES #28-30. USE HANDOUTS #10 AND 11: "TESTING YOUR BUYING FOR INCREASED INCOME," TO ASSIST FARMERS IN SETTING UP A PARTIAL BUDGET FOR A SPECIFIC PURPOSE.

DETERMINE HOW MUCH EACH FARMER CAN AFFORD TO PAY FOR FARM REAL ESTATE.

TO SUMMARIZE (NOTE TO TEACHER)

CAREFUL MANAGEMENT OF A HEAVY DEBT LOAD IS ESSENTIAL FOR SUCCESS IN FARMING TODAY. THREE IMPORTANT TOOLS IN FINANCIAL MANAGEMENT ARE THE BALANCE SHEET, A CASH BUDGET, AND THE RIGHT REPAYMENT TERMS FOR LOANS.

THE BALANCE SHEET SHOWS THE NET WORTH AND THE BREAKDOWN OF CURRENT, INTERMEDIATE, AND FIXED ASSETS AND CURRENT, INTERMEDIATE, AND LONG-TERM LIABILITIES. BALANCE SHEET RATIOS MEASURE THE FINANCIAL STRENGTH OF THE BUSINESS.

THE CASH BUDGET CAN HELP AVOID REPAYMENT PROBLEMS. IF THE CASH BUDGET INDICATES THAT THERE MAY NOT BE ENOUGH CASH AVAILABLE TO COVER FAMILY LIVING EXPENSES, CAPITAL REPLACEMENT AND DEBT SERVICING, CAREFUL ATTENTION SHOULD BE GIVEN TO BOTH THE MANAGEMENT OF THE BUSINESS AND THE LOAN REPAYMENT TERMS.

BY UTILIZING ALL THESE MANAGEMENT TOOLS THE WELL-SCHOOLED FARMER SHOULD BE ABLE TO CALCULATE HIS CREDIT LIMITATIONS. SUCCESS IN THE FARMING SECTOR IN TODAY'S ECONOMY DEMANDS WISDOM, SELF-CONTROL AND FORTITUDE. THE BEST PIECE OF EQUIPMENT THE FARMER HAS JUST COULD BE HIS PENCIL.

APPENDIX A

CONTENT SUMMARY

1. FARM FAMILY GOALS
2. NET WORTH STATEMENTS
3. CASH FLOWS
4. FINANCIAL STATEMENTS
5. COST OF CREDIT
6. BUDGETING

FARM FAMILY GOALS

SETTING GOALS FOR THE BUSINESS MUST BE THE FIRST STEP IN FINANCIAL PLANNING, AND IT IS A CONTINUOUS PROCESS. THERE MAY BE SEVERAL BROAD, LONG-RANGE OBJECTIVES AND MANY SHORT-RANGE GOALS WHICH WILL SERVE AS STEPPING STONES AND A MEASURE OF PROGRESS TOWARD THE ULTIMATE OBJECTIVES. BOTH SETS OF GOALS MAY BE ALTERED ALONG THE WAY BY MODIFYING EITHER THE GOALS THEMSELVES OR THE MEANS BY WHICH THEY WILL BE ACHIEVED.

LEVELING AN 80-ACRE FIELD FOR IRRIGATION MAY BE A SHORT-TERM GOAL, WHILE THE LONG-TERM OBJECTIVE MIGHT BE TO BRING THE ENTIRE FARM UNIT UNDER IRRIGATION. PERHAPS ANOTHER GOAL FOR THE SAME FARM IS TO INCREASE THE VOLUME OF CATTLE FED. REACHING THIS GOAL, HOWEVER, MAY WELL HINGE ON INCREASED FEED PRODUCTION RESULTING FROM THE IRRIGATION PROJECT.

IN A COW HERD OPERATION, AN IMMEDIATE GOAL MIGHT BE TO KEEP 10 PERCENT MORE HEIFERS THAN ARE NEEDED FOR REPLACEMENTS. THE ULTIMATE GOAL MIGHT BE TO INCREASE A 300-COW HERD TO 500 COWS.

PURCHASING AN ADJOINING 80 ACRES COULD BE THE IMMEDIATE GOAL OF A FARMER. IN SO DOING, HE MIGHT BE WORKING TOWARD A LONG-RANGE OBJECTIVE OF INCREASING THE SIZE OF HIS FARM UNIT BY 400 ACRES OVER A PERIOD OF YEARS. MANY OTHER GOALS--GRAIN PRODUCTION, CATTLE FEEDING, SWINE PRODUCTION, LAND USE, ETC.--MAY DEPEND ON WHETHER OR NOT HE IS ABLE TO INCREASE THE SIZE OF HIS UNIT AS PLANNED.

ENTERING INTO THESE DECISIONS OF COURSE IS THE FARM FAMILY. WILL YOUNGER MEMBERS OF THE FAMILY BE ENTERING ACTIVELY INTO THE BUSINESS? HOW MUCH LONGER WILL THE OWNER BE ACTIVELY INVOLVED? IN ADDITION, IT IS ALSO NECESSARY TO DECIDE WHETHER OR NOT LAND OWNERSHIP IS THE MANNER IN WHICH YOU INTEND TO CONTROL THE LAND IN YOUR OPERATION.

NET WORTH STATEMENTS

A NET WORTH STATEMENT SHOWS THE FINANCIAL POSITION AT A GIVEN POINT IN TIME. EVERYTHING OWNED IS ITEMIZED AND VALUED UNDER ASSETS WITH EACH ITEM BEING VALUED AT CURRENT MARKET PRICES. ALL OBLIGATIONS ARE LISTED ON THE LIABILITY SIDE.

ASSETS ARE CATEGORIZED UNDER CURRENT, INTERMEDIATE AND FIXED ASSETS. LIABILITIES ARE DIVIDED INTO CURRENT (DUE WITHIN ONE YEAR), INTERMEDIATE (DUE IN ONE TO SEVEN YEARS) AND LONG-TERM (OVER SEVEN YEARS).

NET WORTH STATEMENTS SHOULD BE PREPARED AT THE SAME TIME EACH YEAR--USUALLY JANUARY 1--IN ORDER TO PROVIDE AN ACCURATE BASIS FOR FINANCIAL GROWTH COMPARISONS.

CASH FLOWS

MORE EFFICIENT MONEY MANAGEMENT IS THE GOAL OF CHARTING CASH FLOW. PREPARATION OF A CASH FLOW SHEET BEGINS BY PLANNING THE TOTAL OPERATING BUDGET. ALL CASH INCOME AND ALL CASH OUTGO IS ESTIMATED TO ACCOUNT FOR THE ENTIRE FLOW OF CASH FUNDS, INCLUDING MONEY BORROWED AND REPAID.

INCOME AND EXPENSE TOTALS ARE FIRST ESTIMATED FOR THE ENTIRE YEAR. THE TOTALS ARE THEN BROKEN DOWN BY MONTH TO SHOW WHERE THE CASH FLOW IS EXPECTED TO OCCUR.

WITH A BREAKDOWN OF PROJECTED MONTHLY INCOME AND EXPENSES, IT BECOMES APPARENT WHEN MONEY WILL NEED TO BE BORROWED AND WHEN INCOME WILL EXCEED EXPENSES TO PERMIT REPAYMENT. BUYING PLANS CAN BE ALTERED TO FIT THE TIMING OF INCOME. AND, PLANS CAN BE MADE TO USE CASH PROFITABLY DURING THOSE PERIODS WHEN IT IS IN EXCESS OF NEEDS.

LENDERS ENCOURAGE FARM BORROWERS TO USE CASH FLOW STATEMENTS. IT PERMITS THE LENDER TO MAKE BETTER CREDIT JUDGMENT. AND, CASH FLOW STATEMENTS MAKE IT EASIER FOR THE OPERATOR TO BORROW FUNDS SINCE HE CAN SHOW WHEN INCOME WILL BE RECEIVED, WHEN AND HOW MUCH HE NEEDS TO BORROW AND WHAT USE HE WILL BE MAKING OF BORROWED MONEY.

FINANCIAL STATEMENTS

FACTUAL DETAILS REGARDING DEBTS ARE IMPORTANT AS THEY TELL WHEN AND WHAT PAYMENTS WILL HAVE TO BE MADE. ALSO, THEY TELL THE LENDER HOW LONG DEBTS HAVE BEEN OUTSTANDING AND WHETHER THEY HAVE BEEN INCREASING OR DECREASING.

PROGRESS OF THE APPLICANT IS SHOWN BY FINANCIAL STATEMENTS OVER SEVERAL YEARS. IF, FOR EXAMPLE, A MAN WHO INHERITED CONSIDERABLE PROPERTY HAS HAD A DECLINING NET WORTH SINCE THAT TIME, THE LENDER IS JUSTIFIED IN SUSPECTING POOR MANAGEMENT. THE LENDER WILL LOOK FURTHER INTO THE SITUATION TO SEE WHETHER THERE MAY BE SOME ABNORMAL DRAIN ON INCOME.

IF, ON THE OTHER HAND, THE STATEMENTS SHOW STEADILY INCREASING NET WORTH WITH NO OUTSIDE HELP, IT CAN BE CONCLUDED THAT THE APPLICANT HAS BEEN SUCCESSFUL IN HIS FARMING ENTERPRISE BY REASON OF GOOD MANAGEMENT.

COST OF CREDIT

WHEN USING CREDIT, IT IS A SOUND BUSINESS PRACTICE (AND GOOD COMMON SENSE) TO FULLY UNDERSTAND THE ENTIRE COST OF BORROWING MONEY. MANY DIFFERENT METHODS OF CALCULATING INTEREST ARE USED AND THE ACTUAL ANNUAL

PERCENTAGE RATE OF INTEREST CHARGED ON A GIVEN AMOUNT WILL VARY CONSIDERABLY ACCORDING TO THE METHOD WHICH IS USED.

THE ACTUAL ANNUAL RATE OF INTEREST CHARGED ON BORROWED MONEY CAN, IN MOST INSTANCES, BE CALCULATED BY USING THE FOLLOWING FORMULA:

$$\frac{\text{TOTAL CHARGES}}{\text{1/2 OF ORIGINAL LOAN}} \times \frac{\text{NO. OF PAYMENTS}}{\text{NO. OF YEARS}} \times \frac{1}{\text{NO. OF PAYMENTS} + 1} = \text{ACTUAL ANNUAL INTEREST RATE}$$

DETERMINING THE TOTAL COST OF USING MONEY IS NOT ALWAYS EASY. UNUSUAL TERMS, CHARGES AND METHODS OF FIGURING INTEREST MAY BE CONFUSING. IN ADDITION TO INTEREST, THERE ALSO MAY BE SUCH COSTS AS CARRYING CHARGES, TIME DIFFERENTIAL CHARGES, FINANCE CHARGES, SALES COMMISSIONS AND DIFFERENCE IN DISCOUNTS GRANTED.

WHEN INTEREST ALONE IS CHARGED, THE ACTUAL COST WILL DEPEND ON WHETHER IT IS CHARGED ON THE UNPAID BALANCE, ON THE ORIGINAL OR FACE AMOUNT OF THE LOAN, OR WHETHER IT IS PAID IN ADVANCE.

BUDGETING

FARM BUDGETING IS DESIGNED SPECIFICALLY AS A GUIDE FOR MANAGEMENT DECISIONS AND FUTURE ACTION. IT IS SIMPLE PAPER AND PENCIL TESTING OF BUSINESS ADJUSTMENTS BEFORE PUTTING THEM INTO ACTUAL OPERATIONS, I.E., TESTING OUT VARIOUS PROGRAMS ON PAPER TO DETERMINE WHICH HAS THE GREATEST PROFIT POTENTIAL.

ESSENTIALLY, BUDGETING CONSISTS OF PROJECTING COSTS AND RETURNS ASSOCIATED WITH A SPECIFIC FARMING ENTERPRISE. THIS PROJECTION PROVIDES FARM AND RANCH OPERATORS WITH RELIABLE ESTIMATES OF EXPECTED NET INCOME UNDER ALTERNATIVE PLANS. WITH THIS INFORMATION, OPERATORS CAN BETTER DECIDE ON THE BEST PROGRAM FOR THEIR CIRCUMSTANCES.

THREE TYPES OF BUDGETS SHOULD BE USED BY FARMERS TO ARRIVE AT THEIR DECISIONS TO MAKE CHANGES IN OPERATING PLANS. THE FIRST STEP IS TO DEVELOP ENTERPRISE BUDGETS--SEPARATE AND COMPLETE BUDGETS FOR EACH PHASE OF THE OPERATION, SUCH AS CATTLE FEEDING, SWINE PRODUCTION, CROP PRODUCTION, ETC.

THEN, THE ENTERPRISE BUDGETS SHOULD BE COMBINED INTO ONE COMPLETE OVERALL FARM BUDGET.

THE THIRD STEP IS TO DEVELOP PARTIAL BUDGETS WHICH CAN BE USED TO ESTIMATE THE EFFECT ON INCOME OF SHIFTING ACRES FROM ONE CROP TO ANOTHER, EXPANDING A LIVESTOCK ENTERPRISE OR SWITCHING FROM ONE SYSTEM OF OPERATION TO ANOTHER.

IN SETTING UP A BUDGET, IT IS IMPORTANT TO INCLUDE ALL COSTS INCLUDING SUCH ITEMS AS DEPRECIATION, INTEREST, PERSONAL PROPERTY TAXES AND INSURANCE AS WELL AS THE MORE OBVIOUS COSTS. ALSO, IT IS NECESSARY TO ESTIMATE PRICES FOR LIVESTOCK AND CROPS AT REALISTIC LEVELS.

THE NUMBER OF SEPARATE ENTERPRISE BUDGETS AND PARTIAL BUDGETS NEEDED WILL DEPEND ON THE SIZE AND RESOURCES OF EACH INDIVIDUAL OPERATION.

IN THE CASE OF A REAL ESTATE DECISION THE PARTIAL BUDGET SHOULD BE UTILIZED TO SHOW THE ANTICIPATED ADDED CAPITAL TO BE GENERATED BY THE ADDITIONAL ACREAGE. AN ESTIMATE OF NET RETURN PER ACRE GIVES THE BORROWER A GOOD GUIDELINE AS TO HIS LIMITS IN TERMS OF THE DOLLARS PER ACRE HE CAN JUSTIFY.

TAKEN FROM CREDIT IN AGRICULTURE. FARM CREDIT BANKS, LOUISVILLE, KENTUCKY.

APPENDIX B

INSTRUCTIONAL MATERIALS

HANDOUTS

H1 - H2	ANALYSIS OF THE NET WORTH STATEMENT
H3 - H4	PROJECTED CASH FLOW
H5 - H6	FARM AND FAMILY FINANCIAL BUDGET
H7 - H8	BALANCE SHEET
H9	CONSUMER CREDIT COSTS
H10 - H11	TESTING YOUR BUYING FOR INCREASED INCOME

TRANSPARENCIES

T1 - T12	ANALYSIS OF THE NET WORTH STATEMENT
T13 - T16	PROJECTED CASH FLOW
T17 - T20	FARM AND FAMILY FINANCIAL BUDGET
T21 - T24	BALANCE SHEET
T25 - T26	CONSUMER CREDIT COSTS
T27 - T28	TESTING YOUR BUYING FOR INCREASED INCOME
T29 - T30	SUMMARY

ANALYSIS OF THE NET WORTH STATEMENT

CASE FARM NET WORTH STATEMENT AS OF Jan. 1, 1971

Property Owned

	Number Value		Value
CURRENT ASSETS		**CURRENT LIABILITIES**	
Crops held for sale	$ 13,079	Store bills	$
Livestock held for sale	$ 13,225	Accounts payable (taxes, etc.)	$
Feed, Seed, Supplies	$	Supply bills	$
Cash on hand	$ 195	Gas and oil bills	$
Checking Account	$ 783	Feed bills	$
Non farm investments	$	Short-term debts	$
Life insurance (cash surrender value)	$ 977		$
		Total Current Liabilities $ 0	
Accounts owed us - collectable	$		
Furniture & equipment	$ 2,520	**DEFERRED LIABILITIES**	
	$	Liens on machinery and equipment (tractor)	$ 5,150
Total Current Assets $ 30,779		Auto Farm Share	$ 350
WORKING ASSETS		Auto Personal Share	$ 350
			$
Farm machinery	$ 16,807	Liens on Livestock	$ 1,030
Auto	$ 1,245	Production Loan	$ 3,120
Farm shop tools	$		$
			$
Purchased breeding livestock	$ 4,756	Liens on crops	$
Raised breeding livestock	$ 7,550		$
Poultry	$		$
Other	$		$
	$	Chattel Mortgages (other)	$
			$
Total Working Assets $ 30.358			$
			$
		Total Deferred Liabilities $ 10,000	
FIXED ASSETS			
Land	$ 64,132		
Farm bldgs., structures, fences	$ 14,713	**LONG-TERM LIABILITIES**	
Dwelling	$ 7,800	Mortgage on Farm Real Estate	$ 29,884
Other Real Estate	$		
	$	Mortgage on other Real Estate	$ 2,800
Total Fixed Assets $ 86,645			$
		Total Long-Term Liabilities $ 32,644	
TOTAL ASSETS	$ 147,782	**TOTAL LIABILITIES**	$ 42,644

Net Worth (Total Assets Minus Total Liabilities) $ 105,138

ANALYSIS OF THE NET WORTH STATEMENT

CASE FARM NET WORTH STATEMENT AS OF ____________

Property Owned

	Number	Value
CURRENT ASSETS		
Crops held for sale		$__________
Livestock held for sale		$__________
Feed, Seed, Supplies		$__________
Cash on hand		$__________
Checking Account		$__________
Non farm investments		$__________
Life insurance (cash surrender value)		$__________
Accounts owed us - collectable		$__________
Furniture & equipment		$__________
		$__________
Total Current Assets $		
WORKING ASSETS		
Farm machinery		$__________
Auto		$__________
Farm shop tools		$__________
Purchased breeding livestock		$__________
Raised breeding livestock		$__________
Poultry		$__________
Other		$__________
		$__________
Total Working Assets $		
FIXED ASSETS		
Land		$__________
Farm bldgs., structures, fences		$__________
Dwelling		$__________
Other Real Estate		$__________
		$__________
Total Fixed Assets $		
TOTAL ASSETS		$__________

	Value
CURRENT LIABILITIES	
Store bills	$__________
Accounts payable (taxes, etc.)	$__________
Supply bills	$__________
Gas and oil bills	$__________
Feed bills	$__________
Short-term debts	$__________
	$__________
Total Current Liabilities $	
DEFERRED LIABILITIES	
Liens on machinery and equipment	$__________
____________________	$__________
____________________	$__________
____________________	$__________
Liens on Livestock	$__________
____________________	$__________
____________________	$__________
____________________	$__________
Liens on crops	$__________
____________________	$__________
____________________	$__________
____________________	$__________
Chattel Mortgages (other)	$__________
____________________	$__________
____________________	$__________
	$__________
Total Deferred Liabilities $	
LONG-TERM LIABILITIES	
Mortgage on Farm Real Estate	$__________
Mortgage on other Real Estate	$__________
	$__________
Total Long-Term Liabilities $	
TOTAL LIABILITIES	$__________

Net Worth (Total Assets Minus Total Liabilities) $____________

PROJECTED CASH FLOW FOR ALTERNATIVE #1 FOR CASE FARM

FARM AND FAMILY FINANCIAL BUDGET

	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
OPERATING SALES													
1. Crops	10832		1570	1174		1177	3194	1483			757		1477
2. Government payment & misc.	412		151		49				132				8
3. Custom work													
4. Livestock products	32305	2509	2568	2924	2698	2794	2932	2924	2764	2692	2542	2568	2390
5. Market livestock sales	6956	729	60	240	650	376	408	1098	931	371	40	1002	1051
6. TOTAL OPERATING SALES	50505	3238	4349	4338	3397	4347	6534	5505	3827	3063	3339	3570	4998
CAPITAL SALES													
7. Livestock (dairy, breeding)	1953	71	73		384				75	920		430	
8. Machinery and equipment													
9. TOTAL CAPITAL SALES	1953	71	73		384				75	920		430	
OPERATING EXPENSES													
10. Hired labor	890	19				150	114	50		29	214	143	171
11. Seeds and plants	323				40	122	116		45				
12. Fertilizer and lime	3112	202		228	137		1100	183		571			691
13. Crop supplies	75						26	34		15			
14. Fuel, oil grease	1168	56	70	45	80	148	172	102	86	84		272	53
15. Drying & storage costs													
16. Machinery repairs	1073	28	120	50	54	16	82	95	25	32	129	147	295
17. Machinery hire & trucking	6										6		
18. Feed Purchased	10384	2689	379	385	379	385	2725	756	972	403	415	439	457
19. Livestock supplies	2444	1250			55			1035			104		
20. Veterinery & Medicine	362				116							20	226
21. Breeding & reg. fees	522	42	46	20	24	76	50	60	24	46	20	50	64
22. Feeder livestock purchases													
23. Utilities	573	50	52	56	58	44	46	40	46	45	52	41	43
24. Auto expense	457		18	132		19			4	230	4	50	
25. Bldg. & Fence repairs	273	2			11	46			125	37	49	3	
26. Taxes, Insurance, Rent	1701	702	48	54	119	3		704		11		60	
27. Miscellaneous	59		16		1						15		27
28. TOTAL OPERATING EXPENSES	23422	5040	749	970	1074	1009	4431	3059	1327	1503	1008	1225	2027

PROJECTED CASH FLOW FOR ALTERNATIVE #1 FOR CASE FARM

CAPITAL EXPENDITURES	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
29. Livestock	10745	8800					555	95	435	860			
30. Machinery	6836		6836										
31. Buildings, fence, tile, etc.	1500							1500					
32. TOTAL CAPITAL EXPENDITURES	19081	8800	6836				555	1595	435	860			
BUDGET SUMMARY													
33. Cash balance (beginning of month													
34. Total operating sales (6)	50505	3238	4349	4338	3397	4347	6534	5505	3827	3063	3339	3570	4998
35. Total capital sales (9)	1953	71	73		384				75	920		430	
36. Nonfarm wages													
37. Other income													
38. Money borrowed this year	20990	13800	6150						1000	40			
39. TOTAL AVAILABLE DOLLARS	73448	17109	10572	4338	3781	4347	6534	5505	4902	4023	3339	4000	4998
40. Operating expense (28)	23422	5040	749	970	1074	1009	4431	3059	1327	1503	1008	1225	2027
41. Capital expenditures (32)	19081	8800	6836				555	1595	435	860			
42. Family living and nonfarm business expenditures (66)	5995	792	766	400	462	421	442	400	421	458	400	633	400
43. Payments on previous year's obligations	9236	586	238	2509	240	241	2242	244	945	246	247	248	1250
44. Payments on current year's borrowed money	2200	185	185	185	185	185	185	185	185	185	185	185	165
45. Interest payments on 43 and 44	3586	266	222	357	220	219	418	216	425	214	213	212	604
46. TOTAL EXPENDITURES	63520	15669	8996	4421	2181	2075	8273	5699	3738	3466	2053	2503	4446
+ or -	+	+	+	-	+	+	-	-	+	+	+	+	+
47. CASH BALANCE (end of month)	9928	1440	1576	83	1600	2272	1739	194	1164	557	1286	1497	552

FARM AND FAMILY FINANCIAL BUDGET

	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
OPERATING SALES													
1. Crops													
2. Government payment & misc.													
3. Custom work													
4. Livestock products													
5. Market livestock sales													
6. TOTAL OPERATING SALES													
CAPITAL SALES													
7. Livestock (dairy, breeding)													
8. Machinery and equipment													
9. TOTAL CAPITAL SALES													
OPERATING EXPENSES													
10. Hired labor													
11. Seeds and plants													
12. Fertilizer and lime													
13. Crop supplies													
14. Fuel, oil grease													
15. Drying & storage costs													
16. Machinery repairs													
17. Machinery hire & trucking													
18. Feed Purchased													
19. Livestock supplies													
20. Veterinery & Medicine													
21. Breeding & reg. fees													
22. Feeder livestock purchases													
23. Utilities													
24. Auto expense													
25. Bldg. & Fence repairs													
26. Taxes, Insurance, Rent													
27. Miscellaneous													
28. TOTAL OPERATING EXPENSES													

CAPITAL EXPENDITURES	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
29. Livestock													
30. Machinery													
31. Buildings, fence, tile, etc.													
32. TOTAL CAPITAL EXPENDITURES													
BUDGET SUMMARY													
33. Cash balance (beginning of month													
34. Total operating sales (6)													
35. Total capital sales (9)													
36. Nonfarm wages													
37. Other income													
38. Money borrowed this year													
39. TOTAL AVAILABLE DOLLARS													
40. Operating expense (28)													
41. Capital expenditures (32)													
42. Family living and nonfarm business expenditures (66)													
43. Payments on previous year's obligations													
44. Payments on current year's borrowed money													
45. Interest payments on 43 and 44													
46. TOTAL EXPENDITURES													
47. CASH BALANCE (end of month)													

BALANCE SHEET FOR: Name ______________________

Address ______________________

Statement Date ______________________

ASSETS

CURRENT:	19__	19__
Cash on Hand	$________	________
Bank Accounts - Checking	________	________
- Savings	________	________
Notes Receivable	________	________
Livestock Held for Sale	________	________
Crops - Held for Sale	________	________
- Held for Feed	________	________
- Investment in Growing Crops	________	________
Marketable Securities	________	________
Cash Value of Life Insurance	________	________
Other Current Assets ____________	________	________
TOTAL CURRENT	$/________/	/________/ (1
INTERMEDIATE:		
Autos and Trucks	$________	________
Machinery and Equipment	________	________
Breeding Livestock (including dairy)	________	________
Other Intermediate Assets __________	________	________
TOTAL INTERMEDIATE	$/________/	/________/ (
FIXED:		
Farmland	$________	________
Improvements	________	________
Nonfarm Real Estate	________	________
Household Furniture and Appliances	________	________
Other Fixed Assets ______________	________	________
TOTAL FIXED	$/________/	/________/ (
TOTAL ASSETS (1+2+3)	$/________/	/________/

LIABILITIES AND NET WORTH

	19__	19__	
CURRENT: (All debts maturing within 12 months)			
Notes Payable - Banks, PCA, or other Lenders	$		
- Relatives			
- Others ________________			
Farm Business Accounts Payable			
Portion of Intermediate Debt Due within 12 Months			
Portion of Long Term Debt Due within 12 Months			
Interest, Rent, and Taxes Due but Unpaid			
Life Insurance Policy Loans			
Personal and Household Accounts Payable			
Other Debt Due within 12 Months			
TOTAL CURRENT	$		(1)
INTERMEDIATE TERM: (All debts maturing in more than one, but less than 10 years - less portion listed under current liabilities.)			
Notes - Bank, PCA, or other lenders	$		
Other Intermediate Term Loans ________________			
TOTAL INTERMEDIATE TERM	$		
LONG TERM: (All debt with maturities of more than 10 years - less portion listed under current liabilities)			
Mortgages on Farm Real Estate ________________	$		
________________			
Mortgages on Other Real Estate			
Other Long Term Debt			
TOTAL LONG TERM	$		(3)
TOTAL LIABILITIES (1+2+3)	$		(4)
NET WORTH* (Total Assets - 4)	$		(5)
Total Liabilities & Net Worth (= Total Assets) (4+5)	$		

*Portion of Net Worth Resulting From Upward Revaluation of Assets ($).

CONSUMER AND MERCHANT CREDIT COSTS

Table For Credit Costs When Charges Are Based On The Beginning Amount Owed and Involve 12 Equal Monthly Installments

Stated Rate of Interest	True Annual Rate of Interest
3% or $3 per $100	5.55%
4% or 4 per 100	7.4
5% or 5 per 100	9.25
6% or 6 per 100	11.1
7% or 7 per 100	12.95
8% or 8 per 100	14.8
9% or 9 per 100	16.65
10% or 10 per 100	18.5
11% or 11 per 100	20.35
12% or 1% per month	22.2

Example: An appliance costing $320 can be purchased for $20 down and $26.75 per month for 12 months. Credit cost = ($26.75 x 12 payments - $300 financed) $21 for $300 or $7 per $100 borrowed. Annual rate of interest is 12.95% or nearly 13% according to the above table

Table for Credit Costs When Charges are Based on the Unpaid Amount Used at the End of the Month

Stated Rate of Interest		True Annual Rate of Interest
1/2 of 1% per month on unpaid balance		6%
3/4 of 1%	"	9%
5/6 of 1%	"	10%
1%	"	12%
1 1/4%	"	15%
1 1/2%	"	18%
2%	"	24%
2 1/2%	"	30%

TESTING YOUR BUYING FOR INCREASED INCOME*

(Partial Budget)

Adjustment to be made Example # 1 Tiling 40 Acres

Investment $6080 ($152 per A.)

"LOSSES" (-)		"GAINS" (+)	
** Added Expenses		Added Income	
Annual Share of Tiling Expense		30 bu. per A. x 40 A.	1200 bu.
$11.04 per A. x 40 A.	$441.60	1200 bu. @ $1	$1200
Harvesting & Storing			
1200 bu. extra @ 10¢	$120.00		
Reduced Income		**Reduced Expenses	
	Total $ 561.60		Total $ 1200.00

(+) "GAINS" $ 1200 minus (-) "LOSSES" $ 561.60 = NET CHANGE $ 638.40
(+ or -)

*Calculate costs and returns on an annual basis.
**Include depreciation, interest, repairs, taxes, insurance and storage.

Consider risk, other alternative uses for your money, etc.
$638.40 ÷ $6080 = $105 return per $1000 invested = 10.5%

TESTING YOUR BUYING FOR INCREASED INCOME*

(Partial Budget)

Adjustment to be made ____

____

"LOSSES" (-)	"GAINS" (+)
** Added Expenses	Added Income
Reduced Income	**Reduced Expenses
Total $________	Total $________

(+) "GAINS" $__________ minus (-) "LOSSES" $__________ = NET CHANGE $__________
(+ or -)

*Calculate costs and returns on an annual basis.
**Include depreciation, interest, repairs, taxes, insurance and storage.

Consider risk, other alternative uses for your money, etc.

H11

ANALYSIS OF THE NET WORTH STATEMENT

CASE FARM NET WORTH STATEMENT AS OF Jan. 1, 1971

Property Owned

	Number Value
CURRENT ASSETS	
Crops held for sale	$ 13,079
Livestock held for sale	$ 13,225
Feed, Seed, Supplies	$
Cash on hand	$ 195
Checking Account	$ 783
Non farm investments	$
Life insurance (cash surrender value)	$ 977
Accounts owed us - collectable	$
Furniture & equipment	$ 2,520
Total Current Assets $ 30,779	

ANALYSIS OF THE NET WORTH STATEMENT

CASE FARM NET WORTH STATEMENT AS OF Jan. 1, 1971

Property Owned

	Number Value
WORKING ASSETS	
Farm machinery	$ 16,807
Auto	$ 1,245
Farm shop tools	$
Purchased breeding livestock	$ 4,756
Raised breeding livestock	$ 7,550
Poultry	$
Other	$
Total Working Assets $ 30,358	

ANALYSIS OF THE NET WORTH STATEMENT

CASE FARM NET WORTH STATEMENT AS OF Jan. 1, 1971

Property Owned

	Number Value
FIXED ASSETS	
Land	$ 64,132
Farm bldgs., structures, fences	$ 14,713
Dwelling	$ 7,800
Other Real Estate	$
Total Fixed Assets $ 86,645	

TOTAL ASSETS $ 147,782

ANALYSIS OF THE NET WORTH STATEMENT

CASE FARM NET WORTH STATEMENT AS OF Jan. 1, 1971

Property Owned

	Value
CURRENT LIABILITIES	
Store bills	$________
Accounts payable (taxes, etc.)	$________
Supply bills	$________
Gas and oil bills	$________
Feed bills	$________
Short-term debts	$________
Total Current Liabilities $ 0	

ANALYSIS OF THE NET WORTH STATEMENT

CASE FARM NET WORTH STATEMENT AS OF Jan. 1, 1971

Property Owned

	Value
DEFERRED LIABILITIES	
Liens on machinery and equipment (tractor)	$ 5,150
Auto Farm Share	$ 350
Auto Personal Share	$ 350
	$
Liens on Livestock	$ 1,030
Production Loan	$ 3,120
	$
	$
Liens on crops	$
	$
	$
	$
Chattel Mortgages (other)	$
	$
	$
Total Deferred Liabilities $ 10,000	

ANALYSIS OF THE NET WORTH STATEMENT

CASE FARM NET WORTH STATEMENT AS OF Jan. 1, 1971

Property Owned

	Value
LONG-TERM LIABILITIES	
Mortgage on Farm Real Estate	$ 29,884
Mortgage on other Real Estate	$ 2,800
Total Long-Term Liabilities $ 32,644	

TOTAL LIABILITIES $ 42,644

Net Worth (Total Assets Minus Total Liabilities) $ 105,138

ANALYSIS OF THE NET WORTH STATEMENT

CASE FARM NET WORTH STATEMENT AS OF ________

Property Owned

	Number Value
CURRENT ASSETS	
Crops held for sale	$__________
Livestock held for sale	$__________
Feed, Seed, Supplies	$__________
Cash on hand	$__________
Checking Account	$__________
Non farm investments	$__________
Life insurance (cash surrender value)	$__________
Accounts owed us - collectable	$__________
Furniture & equipment	$__________
Total Current Assets $	

T7

ANALYSIS OF THE NET WORTH STATEMENT

CASE FARM NET WORTH STATEMENT AS OF ____________

Property Owned

	Number Value
WORKING ASSETS	
Farm machinery	$ ________
Auto	$ ________
Farm shop tools	$ ________
Purchased breeding livestock	$ ________
Raised breeding livestock	$ ________
Poultry	$ ________
Other	$ ________
Total Working Assets $	

T8

ANALYSIS OF THE NET WORTH STATEMENT

CASE FARM NET WORTH STATEMENT AS OF ________

Property Owned

	Number Value
FIXED ASSETS	
Land	$__________
Farm bldgs., structures, fences	$__________
Dwelling	$__________
Other Real Estate	$__________
Total Fixed Assets $	

ANALYSIS OF THE NET WORTH STATEMENT

CASE FARM NET WORTH STATEMENT AS OF ________

Property Owned

	Value
CURRENT LIABILITIES	
Store bills	$________
Accounts payable (taxes, etc.	$________
Supply bills	$________
Gas and oil bills	$________
Feed bills	$________
Short-term debts	$________
Total Current Liabilities $	

ANALYSIS OF THE NET WORTH STATEMENT

CASE FARM NET WORTH STATEMENT AS OF __________

Property Owned

	Value
DEFERRED LIABILITIES	
Liens on machinery and equipment (tractor)	$__________
______________________	$__________
______________________	$__________
______________________	$__________
Liens on Livestock	$__________
______________________	$__________
______________________	$__________
______________________	$__________
Liens on crops	$__________
______________________	$__________
______________________	$__________
______________________	$__________
Chattel Mortgages (other)	$__________
______________________	$__________
______________________	$__________
Total Deferred Liabilities $	

ANALYSIS OF THE NET WORTH STATEMENT

CASE FARM NET WORTH STATEMENT AS OF ________

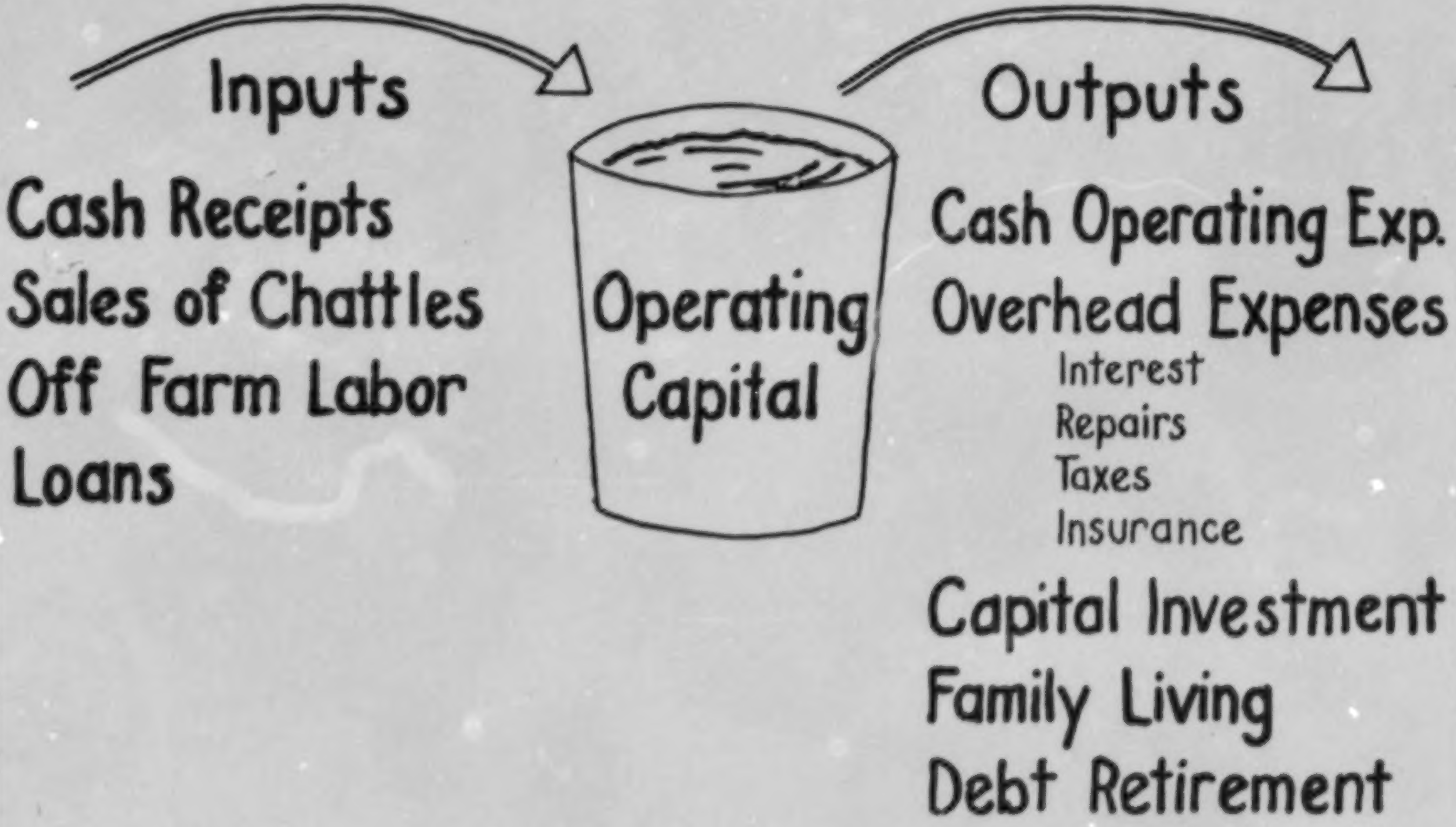
Property Owned

	Value
LONG-TERM LIABILITIES	
Mortgage on Farm Real Estate	$________
Mortgage on other Real Estate	$________
Total Long-Term Liabilities $	
TOTAL LIABILITIES	

Net Worth (Total Assets Minus Total Liabilities) $________

T12

Cash Flow



Inputs

Cash Receipts
Sales of Chattles
Off Farm Labor
Loans

Operating Capital

Outputs

Cash Operating Exp.
Overhead Expenses
- Interest
- Repairs
- Taxes
- Insurance

Capital Investment
Family Living
Debt Retirement

PROJECTED CASH FLOW FOR ALTERNATIVE #1 FOR CASE FARM

FARM AND FAMILY FINANCIAL BUDGET

	Total
OPERATING SALES	
1. Crops	10832
2. Government payment & misc.	412
3. Custom work	
4. Livestock products	32305
5. Market livestock sales	6956
6. TOTAL OPERATING SALES	50505
CAPITAL SALES	
7. Livestock (dairy, breeding)	1953
8. Machinery and equipment	
9. TOTAL CAPITAL SALES	1953

PROJECTED CASH FLOW FOR ALTERNATIVE #I FOR CASE FARM

FARM AND FAMILY FINANCIAL BUDGET

	Total
OPERATING EXPENSES	
10. Hired labor	890
11. Seeds and plants	323
12. Fertilizer and lime	3112
13. Crop supplies	75
14. Fuel, oil grease	1168
15. Drying & storage costs	
16. Machinery repairs	1073
17. Machinery hire & trucking	6
18. Feed Purchased	10384
19. Livestock supplies	2444
20. Veterinery & Medicine	362
21. Breeding & reg. fees	522
22. Feeder livestock purchases	
23. Utilities	573
24. Auto expense	457
25. Bldg. & Fence repairs	273
26. Taxes, Insurance, Rent	1701
27. Miscellaneous	59
28. TOTAL OPERATING EXPENSES	23422

PROJECTED CASH FLOW FOR ALTERNATIVE #1 FOR CASE FARM

		Total
CAPITAL EXPENDITURES		
29.	Livestock	10745
30.	Machinery	6836
31.	Buildings, fence, tile, etc.	1500
32.	TOTAL CAPITAL EXPENDITURES	19081
BUDGET SUMMARY		
33.	Cash balance (beginning of month)	
34.	Total operating sales (6)	50505
35.	Total capital sales (9)	1953
36.	Nonfarm wages	
37.	Other income	
38.	Money borrowed this year	20990
39.	TOTAL AVAILABLE DOLLARS	73448
40.	Operating expense (28)	23422
41.	Capital expenditures (32)	19081
42.	Family living and nonfarm business expenditures (66)	5995
43.	Payment on previous year's obligations	9236
44.	Payments on current year's borrowed money	2200
45.	Interest payments on 43 and 44	3586
46.	TOTAL EXPENDITURES	63520
47.	CASH BALANCE (end of month)	9928

FARM AND FAMILY FINANCIAL BUDGET

	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
OPERATING SALES 1. Crops													
2. Government payment & misc.													
3. Custom work													
4. Livestock products													
5. Market livestock sales													
6. TOTAL OPERATING SALES													
CAPITAL SALES 7. Livestock (dairy, breeding)													
8. Machinery and equipment													
9. TOTAL CAPITAL SALES													

T17

FARM AND FAMILY FINANCIAL BUDGET

	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
OPERATING EXPENSES 10. Hired labor													
11. Seeds and plants													
12. Fertilizer and lime													
13. Crop supplies													
14. Fuel, oil grease													
15. Drying & storage costs													
16. Machinery repairs													
17. Machinery hire & trucking													
18. Feed Purchased													
19. Livestock supplies													
20. Veterinery & Medicine													
21. Breeding & reg. fees													
22. Feeder livestock purchases													
23. Utilities													
24. Auto expense													
25. Bldg. & Fence repairs													
26. Taxes, Insurance, Rent													
27. Miscellaneous													
28. TOTAL OPERATING EXPENSES													

FARM AND FAMILY FINANCIAL BUDGET

	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
CAPITAL EXPENDITURES 29. Livestock													
30. Machinery													
31. Buildings, fence, tile, etc.													
32. TOTAL CAPITAL EXPENDITURES													
BUDGET SUMMARY 33. Cash balance (beginning of month)													
34. Total operating sales (6)													
35. Total capital sales (9)													
36. Nonfarm wages													
37. Other income													
38. Money borrowed this year													
39. TOTAL AVAILABLE DOLLARS													

FARM AND FAMILY FINANCIAL BUDGET

	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
40. Operating expense (28)													
41. Capital expenditures (32)													
42. Family living and nonfarm business expenditures (66)													
43. Payments on previous year's obligations													
44. Payments on current year's borrowed money													
45. Interest payments on 43 and 44													
46. TOTAL EXPENDITURES													
47. CASH BALANCE (end of month)													

BALANCE SHEET FOR: Name ____________

Address ____________

Statement Date ____________

ASSETS

CURRENT:	19__	19__	
Cash on Hand	$		
Bank Accounts - Checking			
- Savings			
Notes Receivable			
Livestock Held for Sale			
Crops - Held for Sale			
-Held for Feed			
-Investment in Growing Crops			
Marketable Securities			
Cash Value of Life Insurance			
Other Current Assets ____________			
TOTAL CURRENT	$		(I)

BALANCE SHEET FOR: Name ________________

Address ________________

Statement Date ________________

ASSETS

INTERMEDIATE:	19__	19__	
Autos and Trucks	$______	______	
Machinery and Equipment	$______	______	
Breeding Livestock (including dairy)	$______	______	
Other Intermediate Assets ______	$______	______	
TOTAL INTERMEDIATE	$______	______	(2)
FIXED:			
Farmland	$______	______	
Improvements	$______	______	
Nonfarm Real Estate	$______	______	
Household Furniture and Appliances	$______	______	
Other Fixed Assets ______	$______	______	
TOTAL FIXED	$______	______	(3)
TOTAL ASSETS (1+2+3)	$______	______	

LIABILITIES AND NET WORTH

CURRENT: (All debts maturing within 12 months)	19__	19__	
Notes Payable - Banks, PCA, or other Lenders	$______	______	
-Relatives	______	______	
-Others ______________	______	______	
Farm Business Accounts Payable	______	______	
Portion of Intermediate Debt Due within 12 Months	______	______	
Portion of Long Term Debt Due within 12 Months	______	______	
Interest, Rent, and Taxes Due but Unpaid	______	______	
Life Insurance Policy Loans	______	______	
Personal and Household Accounts Payable	______	______	
Other Debt Due within 12 Months	______	______	
TOTAL CURRENT	$______	______	(1)

INTERMEDIATE TERM: (All debts maturing in more than one, but less than 10 years - less portion listed under current liabilities.)			
Notes - Bank, PCA, or other lenders	$______	______	
Other Intermediate Term Loans __________	______	______	
TOTAL INTERMEDIATE TERM	$______	______	(2)

LIABILITIES AND NET WORTH

		19__	19__	
LONG TERM: (All debt with maturities of more than 10 years - less portion listed under current liabilities)				
Mortgages on Farm Real Estate	______	$______	______	
	______	______	______	
Mortgages on Other Real Estate		______	______	
Other Long Term Debt		______	______	
TOTAL LONG TERM		$______	______	(3)
TOTAL LIABILITIES (1+2+3)		$______	______	(4)
NET WORTH* (Total Assets - 4)		$______	______	(5)
Total Liabilities & Net Worth (= Total Assets) (4 + 5)		$______	______	

*Portion of Net Worth Resulting From Upward Revaluation of Assets ($).

CONSUMER AND MERCHANT CREDIT COSTS

Table For Credit Costs When Charges Are Based On The Beginning Amount Owed and Involve 12 Equal Monthly Installments

Stated Rate of Interest	True Annual Rate of Interest
3% or $3 per $100	5.55%
4% or 4 per 100	7.4
5% or 5 per 100	9.25
6% or 6 per 100	11.1
7% or 7 per 100	12.95
8% or 8 per 100	14.8
9% or 9 per 100	16.65
10% or 10 per 100	18.5
11% or 11 per 100	20.35
12% or 12 per 100	22.2

Example: An appliance costing $320 can be purchased for $20 down and $26.75 per month for 12 months. Credit cost = ($26.75 x 12 payments - $300 financed) $21 for $300 or $7 per $100 borrowed. Annual rate of interest is 12.95% or nearly 13% according to the above table.

CONSUMER AND MERCHANT CREDIT COSTS

Table for Credit Costs When Charges are Based on the Unpaid Amount Used at the End of the Month

Stated Rate of Interest		True Annual Rate of Interest
1/2 of 1% per month on unpaid balance		6%
3/4 of 1%	"	9%
5/6 of 1%	"	10%
1%	"	12%
1 1/4%	"	15%
1 1/2%	"	18%
2%	"	24%
2 1/2%	"	30%

561

(Partial Budget)

Adjustment to be made Example # 1 Tiling 40 Acres

Investment $6080 ($152 per A.)

"LOSSES" (-)		"GAINS" (+)	
**Added Expenses		Added Income	
Annual Share of Tiling Expense		30 bu. per A. x 40 A.	1200 bu.
$11.04 per A. x 40 A.	$441.60	1200 bu. @ $1	$1200
Harvesting & Storing			
1200 bu. extra @ 10¢	$120.00		
Total	$561.60	Total	$1200.00

(+) "GAINS" $1200 minus (-) "LOSSES" $ 561.60 = NET CHANGE $ 638.40 (+ or -)

*Calculate costs and returns on an annual basis.

**Include depreciation, interest, repairs, taxes, insurance and storage.

Consider risk, other alternative uses for your money, etc.
$638.40 - $6080 = $105 return per $1000 invested = 10.5%

T27

TESTING YOUR BUYING FOR INCREASED INCOME*

(Partial Budget)

Adjustment to be made ______________________________

____

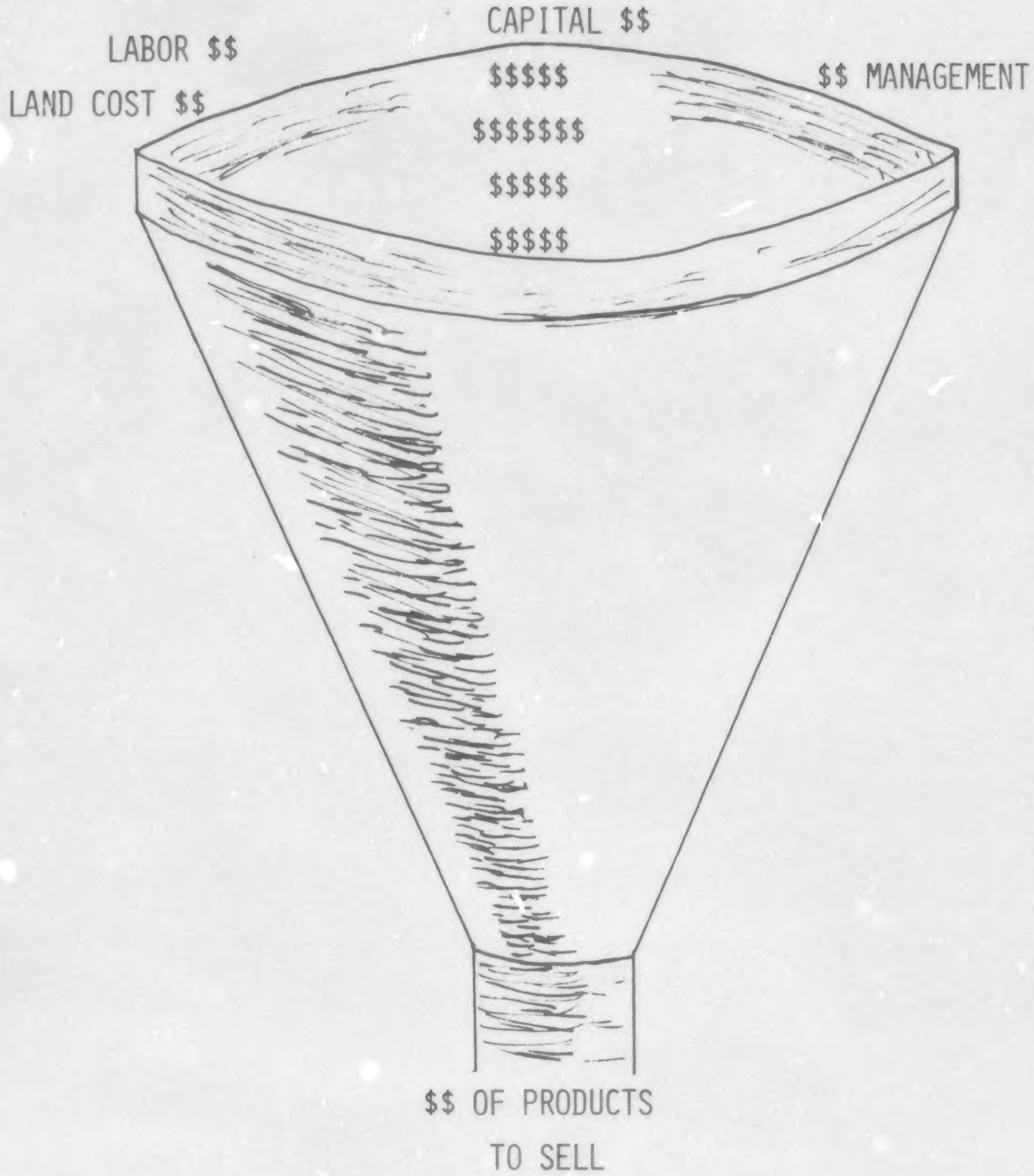
"LOSSES" (-)	"GAINS" (+)
**Added Expenses	Added Income
Reduced Income	**Reduced Expenses
Total $______	Total $______

(+) "GAINS" $________ minus (-) "LOSSES" $________ = NET CHANGE $________ (+ or -)

*Calculate costs and returns on an annual basis.

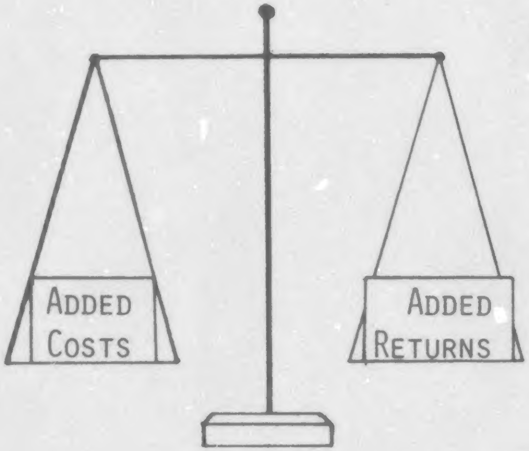
**Include depreciation, interest, repairs, taxes, insurance and storage.

Consider risk, other alternative uses for your money, etc.

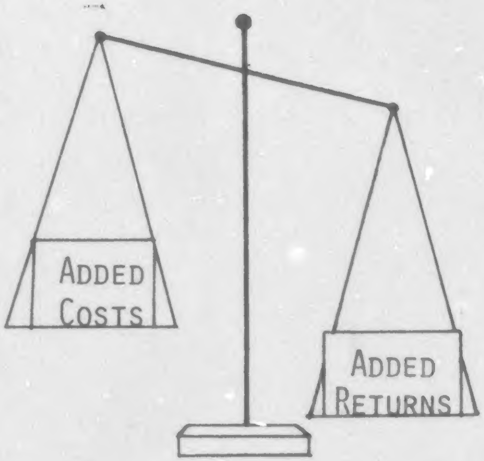

CAPITAL $$
LABOR $$
LAND COST $$
$$ MANAGEMENT
$$$$$
$$$$$$$
$$$$$
$$$$$
$$ OF PRODUCTS TO SELL

T29

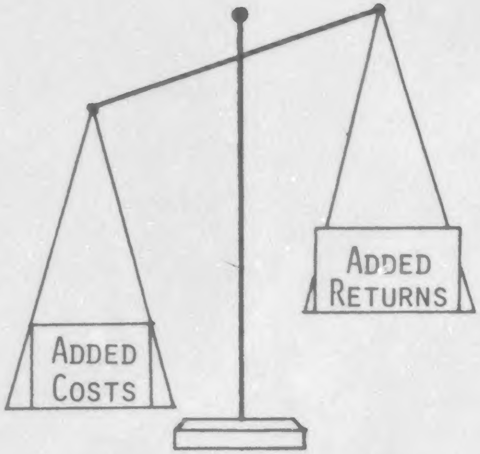
WEIGH AND DECIDE:


ADDED COSTS
ADDED RETURNS

(A) NO ADDED PROFIT


ADDED COSTS
ADDED RETURNS

(B) ADDED PROFIT


ADDED COSTS
ADDED RETURNS

(C) LOSS

Adult Unit No. 19

MANAGEMENT OF OPERATING COSTS FOR CORN AND SOYBEAN CROP PRODUCTION

A Resource Unit For Adult Education Classes in Agriculture

Developed by
Carmen Cummins

Edited by
J. David McCracken

Department of Agricultural Education
College of Agriculture and Home Economics
The Ohio State University
Columbus, Ohio 43210

1975

566

Preface

This resource unit was developed as a part of a project titled, "Inservice Education of Vocational Agriculture Teachers on New Curricular Materials for Adult Class Instruction." Educational Professional Development Act Funds were obtained from the Regional U. S. Office of Education in Chicago through the State Department of Education, Division of Vocational Education in Ohio to conduct the project. The project was conducted from August 1, 1974 through July 31, 1975. Included in the project were workshops which provided instruction concerning development and utilization of the units.

The project staff consisted of J. David McCracken and Lawrence H. Newcomb, Project Co-Directors and Wayne R. Longbrake, Graduate Research Associate. Special appreciation is expressed to Mr. Longbrake who assumed much of the responsibility in assisting authors with the specific content of the units. Appreciation is also expressed to each of the vocational agriculture teachers in the State of Ohio who assisted with the project by developing units and by field testing the initial units prior to their revision and final preparation.

J. David McCracken Assistant Professor	L. H. Newcomb Assistant Professor

TABLE OF CONTENTS

PAGE

PREFACE III

INTRODUCTION 1

STATE SITUATION 3

LOCAL SITUATION 3

OBJECTIVES 3

REFERENCES 3

NEEDED AV EQUIPMENT 4

ALTERNATIVE INTEREST APPROACHES 4

QUESTIONS TO BE ANSWERED 4

LEARNING ACTIVITIES 4

SUMMARIZE (NOTE TO TEACHER) 5

APPLICATION 5

APPENDIX A: CONTENT SUMMARY 6

APPENDIX B: INSTRUCTIONAL MATERIALS 8

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

569

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATABLE TO THE LOCAL COMMUNITY.

MANAGEMENT OF OPERATING COSTS

FOR CORN AND SOYBEAN CROP PRODUCTION

STATE AND NATIONAL SITUATION

AT THE PRESENT RATE OF INFLATION AND THE HIGH DEGREE OF UNCERTAINITY IN AMERICAN AGRICULTURE PRELIMINARY BUDGETING IS BECOMING MORE IMPORTANT ON A STATE AND NATIONAL BASIS. WE MUST BE AWARE OF PRODUCTION COSTS FOR CORN AND SOYBEANS, STATE AND NATIONALLY, AND AS THEY RELATE TO YOUR LOCAL SITUATION, INCLUDING TILLAGE AND OTHER PRODUCTION PRACTICES. (SEE TRANSPARENCIES T-1 AND T-2)

LOCAL SITUATION

THE VOCATIONAL AGRICULTURE INSTRUCTOR SHOULD MAKE SEVERAL VISITS TO AREA FARMERS TO COLLECT DATA TO BE USED WITH THIS UNIT. THE INFORMATION PERTAINING TO AREA FARMERS COULD BE PRESENTED AS A PANEL OR ONE OR TWO OUTSTANDING FARMERS COULD HELP IN THE PRESENTATION. THE LOCAL INSTRUCTOR MAY NEED TO INTERPRET THE RELATIONSHIP BETWEEN DIFFERENT FARMING OPERATIONS AS PERTAINING TO OWNER, TENANT, CASH RENT, 50-50 AND 60-40 AGREEMENTS IN EXPLAINING ANY DIFFERENCES IN BUDGETING THAT MAY NEED TO TAKE PLACE. IN THE COLLECTION OF DATA AT LEAST TWO YEARS RECORDS PRIOR TO THIS YEAR SHOULD BE COLLECTED TO BE USED IN MAKING COMPARISONS. ALSO, THE INSTRUCTOR MAY WANT TO TAKE SLIDES OF THE CROPS AT DIFFERENT STAGES OF PRODUCTION FOR USE AS AN INTEREST APPROACH.

OBJECTIVES

1. IDENTIFY THE TYPICAL COSTS INVOLVED IN CORN AND SOYBEAN PRODUCTION.
2. PROJECT THE COSTS OF PRODUCTION FOR THE COMING CORN AND SOYBEAN CROP YEAR.
3. DETERMINE PROFITS AT DIFFERENT LEVELS OF INPUT COSTS, YIELDS AND MARKET PRICES THROUGH THE USE OF BUDGETING.

REFERENCES

"AGRICULTURAL EDUCATION SERVICE AND DEPARTMENT OF AGRICULTURAL EDUCATION." FARM BUSINESS PLANNING AND ANALYSIS TEACHING UNITS. COLUMBUS, OHIO. THE OHIO STATE UNIVERSITY, AGDEX 810, 1971.

"DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY." FARM BUSINESS ANALYSIS REPORT, CROP SUMMARY. COLUMBUS, OHIO. COOPERATIVE EXTENSION SERVICE, THE OHIO STATE UNIVERSITY PUBLICATION NUMBERS MM-333, 1973-1974.

"DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY." OHIO CROPS ENTERPRISE BUDGETS 1975. COLUMBUS, OHIO. COOPERATIVE EXTENSION SERVICE, THE OHIO STATE UNIVERSITY PUBLICATION NUMBER MM-35D, 1975.

SHAUDYS, E. T. AND BAKER, R. H. FARM CUSTOM RATES PAID IN OHIO, 1974. COLUMBUS, OHIO. COOPERATIVE EXTENSION SERVICE, THE OHIO STATE UNIVERSITY, PUBLICATION NUMBER L-74, MAY, 1974.

NEEDED AV EQUIPMENT

OVERHEAD PROJECTOR, SLIDE PROJECTOR, AND CHALKBOARD.

ALTERNATIVE INTEREST APPROACHES

ALTERNATIVE A. PANEL OF FARMERS SHOULD LIST THEIR COST OF PRODUCTION FOR THE PAST TWO YEARS; PLOT THE INFORMATION ON CHALKBOARD.

ALTERNATIVE B. WHICH ITEMS OF PRODUCTION WILL BE MOST CRITICAL IN THE COMING YEAR? (FERTILIZER, OPERATING MONEY, SEED)

ALTERNATIVE C. HOW MUCH WILL YOUR PRODUCTION COSTS INCREASE IN THE COMING YEAR? (20-30-40%)

ALTERNATIVE D. IN THE COMING CROP YEAR WHO WILL MAKE THE MOST PROFIT ON YOUR CORN AND SOYBEANS, YOU OR THE BANK? (HIGH INTEREST)

QUESTIONS TO BE ANSWERED

1. WHAT ARE YOUR PRODUCTION COSTS IN GROWING CORN AND SOYBEANS? (COMPARE PAST TWO YEARS RECORDS.)

2. HOW MUCH WILL YOUR PRODUCTION COSTS INCREASE THIS COMING YEAR?

3. WHAT RANGE OR LEVEL OF PROFIT CAN YOU EXPECT FOR THE COMING YEAR?

LEARNING ACTIVITIES

1. WHAT ARE YOUR PRODUCTION COSTS IN GROWING CORN AND SOYBEANS? (COMPARE PAST TWO YEARS RECORDS.)

SHOW SLIDES OF CROPS AT DIFFERENT STAGES OF PRODUCTION TO BRING OUT TILLAGE AND OTHER APPROVED PRACTICES FOR YOUR FARMING AREA. (SPRAY PROGRAMS, PLANT ANALYSIS)

USE TRANSPARENCIES OF OHIO CORN AND SOYBEAN PRODUCTION COST FOR THE PAST TWO YEARS. (USE TRANSPARENCIES #3-20.)

COMPARE OTHER STATES COSTS OF PRODUCTION. USE TRANSPARENCIES #1 AND 2.

2. HOW MUCH WILL YOUR PRODUCTION COSTS INCREASE THIS COMING YEAR?

SURVEY CLASS MEMBERS FOR HOW MUCH THEY ESTIMATE PRODUCTION COSTS TO BE.

USE HANDOUTS OF PRELIMINARY BUDGETS FOR CORN AND SOYBEAN PRODUCTION IN THE COMING YEAR. (HANDOUTS #1-3)

3. WHAT RANGE OR LEVEL OF PROFIT CAN YOU EXPECT FOR THE COMING YEAR?

USE HANDOUTS #1-3 AND TRANSPARENCIES #21 AND 22 AS WORKSHEETS FOR EACH FARMER TO ENTER HIS OWN FIGURES ACCORDING TO HIS CULTURAL PRACTICES.

USE TRANSPARENCIES #16-18, 23-25 AND HANDOUT #4 AS TRANSPARENCIES AND A WORKSHEET FOR PLANNING A CROP ROTATION WHICH WILL PROVIDE THE BEST CROP COMBINATION FOR LARGEST TOTAL PROFIT.

SUMMARIZE (NOTE TO TEACHER)

AT THIS POINT IT WILL BE NECESSARY FOR EACH CLASS MEMBER TO BE ABLE TO DETERMINE HIS LEVEL OF INPUTS AND OUTPUT. KNOWING THAT THE COMING PRODUCTION YEAR WILL RESULT IN HIGHER COSTS THE CLASS MEMBER SHOULD BUDGET HIS OPERATING COSTS AS CLOSELY AS POSSIBLE TO MAXIMIZE PROFITS. THE VOCATIONAL AGRICULTURE INSTRUCTOR SHOULD EMPHASIZE THE IMPORTANCE OF BUDGETING AND HOW THE BUDGET CAN BE UPDATED AS MORE CURRENT INFORMATION BECOMES AVAILABLE.

APPLICATION

SINCE EACH CLASS MEMBER'S COSTS OF INPUTS AND LEVELS OF PROFIT WILL VARY, THE INSTRUCTOR SHOULD FOLLOW UP THIS MEETING WITH A SUPERVISORY VISIT TO HELP EACH CLASS MEMBER WITH HIS RESPECTIVE BUDGET. THE RESULTS OF SUCH BUDGETING CAN BE EVALUATED THE FOLLOWING YEAR IN ANOTHER CLASS DESIGNED TO PROJECT AHEAD FOR COSTS IN THE YEAR HENCE COMING.

573

APPENDIX A

CONTENT SUMMARY

MANAGEMENT OF OPERATING COSTS

FOR CORN AND SOYBEAN CROP PRODUCTION

THE MANAGEMENT OF OPERATING COSTS FOR CORN AND SOYBEAN CROP PRODUCTION CAN BE BEST TAUGHT AFTER SOME RESEARCH HAS BEEN DONE ON THE LOCAL LEVEL. THE INSTRUCTOR MUST BE AWARE OF LOCAL CULTURAL PRACTICES AND MAKE ANY CHANGE NECESSARY IN THE INSTRUCTIONAL MATERIALS TO FIT THE PARTICULAR SITUATION. CERTAINLY EVERY SCHOOL DISTRICT HAS SOME KEY FARMERS WHO YOU CAN RELY ON FOR A PANEL TO SERVE AS EXPERTS OR WHO WOULD PROVIDE INFORMATION FOR YOU TO USE. USE YOUR COUNTY OR AREA EXTENSION AGENT TO UP-DATE THE INFORMATION AND INCLUDE THEM AS POSSIBILITIES ON YOUR PANEL ALONG WITH REPRESENTATIVES FROM THE AGRICULTURE INDUSTRY.

FAMILIARIZE THE CLASS MEMBERS WITH THE DIFFERENT INPUTS IN PRODUCING CORN AND SOYBEANS AND THAT YOUR PURPOSE IS TO HELP THEM OBTAIN THE GREATEST PROFIT. THEREFORE, THEY NEED TO CONSIDER THE PRACTICES WHICH WILL RESULT IN OPTIMUM EFFICIENCY. THE BUDGETS HAVE BEEN MADE VERY INCLUSIVE TO FIT THE EXTREME SITUATION AND YOU MAY WANT TO DELETE OR ADJUST SOME ITEMS DEPENDING ON THE SITUATION.

AFTER THEY HAVE MADE SOME COMPARISON WITH THE INFORMATION PRESENTED BY A PANEL OR ANOTHER TECHNIQUE, THEY MUST BE MOST CONCERNED ABOUT THEIR OWN OPERATION AND NOT THEIR NEIGHBORS. ENCOURAGE INTERACTION AND GROUP DISCUSSION, BUT REMEMBER THAT EACH CLASS MEMBER SHOULD HAVE A BUDGET THAT FITS HIS FARM OPERATION.

EACH CLASS MEMBER SHOULD RECEIVE A SUPERVISORY VISIT TO DISCUSS HIS FARM SITUATION AND THEN A FOLLOW-UP VISIT IN THE SUMMER TO EVALUATE THE BUDGETING PROCESS AT THAT POINT.

APPENDIX B

INSTRUCTIONAL MATERIALS

HANDOUTS

H-1 - H-3	PRELIMINARY BUDGET
H-4	PLANNING CROP ROTATION

TRANSPARENCIES

T-1 - T-2	PRODUCTION COSTS PER ACRE
T-3 - T-6	CORN ENTERPRISE SUMMARY 1972
T-7 - T-10	SOYBEAN ENTERPRISE SUMMARY 1972
T-11 - T-15	CORN ENTERPRISE SUMMARY 1973
T-16 - T-20	SOYBEAN ENTERPRISE SUMMARY 1973
T-21	PRELIMINARY BUDGET FOR CORN
T-22	PRELIMINARY BUDGET FOR SOYBEANS
T-23 - T-24	CORN AND SOYBEAN PRICES
T-25	PLANNING CORP ROTATION

1975 CORN PRODUCTION BUDGETS

ITEM	EXPLANATION	PRICE PER UNIT	YIELD LEVEL 80 bu.	110 bu.	140 bu.	YOUR BUDGET
RECEIPTS		$ 3.00/bu.	$240.00	$330.00	$420.00	$
EXPENSES						
Seed	1 bushel to 3 acres	$39.00/bu.	$ 13.00	$ 13.00	$ 13.00	
Fertilizer						
Nitrogen	80, 110, 150#	.40/#	32.00	44.00	60.00	
Phosphorus	30, 40, 50#	.25/#	7.50	10.00	12.50	
Potash	70, 100, 150#	.10/#	7.00	10.00	15.00	
Lime	1000#	8.00/T.	4.00	4.00	4.00	
Spray						
Herbicides						
Atrazine	2# 80W	3.00/#	6.00	6.00	6.00	
Lasso	2 qt.	17.55/gal.	8.78	8.78	8.78	
Insecticides						
Fungicide						
Crop Insurance		1.25/A.	1.25	1.25	1.25	
Supplies & Miscellaneous 1/		10.00/A.	10.00	10.00	10.00	
Interest on Operating Capital	7 mo.	10%	5.19	6.20	7.57	
Field Operations 2/						
Plow	1 time	8.00/A.	8.00	8.00	8.00	
Fitting	2 times	4.00/A.	8.00	8.00	8.00	
Land Leveling and/or surface drainage						
Planting	1 time	5.00/A.	5.00	5.00	5.00	
Cultivation	2 times	4.00/A.	8.00	8.00	8.00	
Spraying	1 time	2.50/A.	2.50	2.50	2.50	
Harvesting	1 time	15.00/A.	15.00	15.00	15.00	
Trucking		.12/bu.	9.60	13.20	16.80	
Drying 3/		.12/bu.	9.60	13.20	16.80	
Land	rent		35.00	50.00	65.00	
Estimated additional operating labor 1 hr.		3.50/hr.	3.50	3.50	3.50	
TOTAL EXPENSES			$198.92	$239.63	$286.70	$
RETURN TO MANAGEMENT AND PROFIT			$ 41.08	$ 90.37	$133.30	$

1/ Soil and plant analysis; Workmen's Compensation; shop tools, equipment, etc.
2/ Cost of machine operation and labor.
3/ 25% to 15.5% moisture.

1975 SOYBEAN PRODUCTION BUDGETS

ITEM	EXPLANATION	PRICE PER UNIT	YIELD LEVEL			YOUR BUDGET
			25 bu.	35 bu.	45 bu.	
RECEIPTS		$ 6.50/bu.	$162.50	$227.50	$292.50	$
EXPENSES						
Seed	1 1/4 bu.	$12.00/bu.	$ 15.00	$ 15.00	$ 15.00	$
Fertilizer						
Nitrogen						
Phosphorus	30, 40, 50#	.25/#	7.50	10.00	12.50	
Potash	40, 50, 70#	.10/#	4.00	5.00	7.00	
Lime	1000#	8.00/T	4.00	4.00	4.00	
Manganese SO^4	8#	.12/#	.96	.96	.96	
Spray						
Herbicides						
Lorox	2#	4.00/#	8.00	8.00	8.00	
Lasso	2 qt.	17.55/gal.	8.78	8.78	8.78	
Insecticides						
Fungicides						
Crop Insurance		2.50/A	2.50	2.50	2.50	
Supplies & Miscellaneous 1/		10.00/A	10.00	10.00	10.00	
Interest on Operating Capital	6 mo.	10%	3.04	3.21	3.44	
Field Operations 2/						
Plow		8.00/A	8.00	8.00	8.00	
Fitting	2 times	4.00/A	8.00	8.00	8.00	
Land Leveling and/or surface drainage						
Planting		5.00/A	5.00	5.00	5.00	
Cultivation	2 times	4.00/A	8.00	8.00	8.00	
Spraying	2 times	2.50/A	5.00	5.00	5.00	
Harvesting		12.00/A	12.00	12.00	12.00	
Trucking		.12/bu.	3.00	4.20	5.40	
Drying						
Land	rent		35.00	50.00	65.00	
Estimated additional operating labor 1 hr		3.50/hr.	3.50	3.50	3.50	
TOTAL EXPENSES			$151.28	$171.15	$192.08	$
RETURN TO MANAGEMENT AND PROFIT			$ 11.22	$ 56.35	$100.42	$

1/ Soil and plant analysis; Workmen's Compensation; shop tools, equipment etc.

2/ Cost of machine operation and labor.

BUDGET GUIDELINES

With dramatic price changes today, it is necessary to re-evaluate a farming program annually before starting the new crop season.

The attached budgets were developed in January, 1975. They were prepared as guidelines for planning crop enterprises in Ohio during 1975.

The blank spaces provided at the right of each budget should be used to reflect the users actual situation and production practices.

When projecting a budget for your own situation, be certain to use costs and returns that reflects your own production and management practices. The prices you use should reflect your purchasing and marketing situation. Quantities of items used and sold should be based upon your experience.

For individuals who want to determine actual costs of production, a farm business analysis would be useful. County Extension Agents and Vocational Agriculture teachers should be contacted for information concerning the Ohio State University Farm Business Analysis Program.

PLANNING CROP ROTATION

Crops	ALT. 1			ALT. 2			ALT. 3		
	Acres	(1) Your Est. Profit/A.	Total Est. Profit	Acres	(1) Your Est. Profit/A.	Total Est. Profit	Acres	(1) Your Est. Profit/A.	Total Est. Profit
TOTAL		XXXXXXXXX			XXXXXXXXX			XXXXXXXXX	

(1) Use Work Sheets for crops, adjusted for your farm

COSTS PER ACRE OF GROWING CORN AND SOYBEANS--1973 AND 1970-1973 AVERAGE, 411 GRAIN FARMS (NO LIVESTOCK), CENTRAL ILLINOIS

	Corn		Soybeans	
	Average, 1970-1973	1973	Average, 1970-1973	1973
Number of acres grown per farm	267	263	215	279
Percent of tillable land	49.2	46.8	39.7	49.6
Yield per acre (bu.)	124	130	42	40
Total number of bushels produced	33,108	34,190	9,030	11,160
Net farm price received	$ 1.28	...	$ 3.27	...
Variable costs:				
Soil fertility	$ 19	$ 26[a]	$ 8	$ 9
Seed, crop, and drying expenses	14	15	13	17
Machinery repair, fuel, and hire	14	14	10	12
TOTAL VARIABLE COSTS	$ 47	$ 55	$ 31	$ 38

---

[a] Some farmers applied and paid for more than one year's supply in 1973.

T1

COSTS PER ACRE OF GROWING CORN AND SOYBEANS--1973 AND 1970-1973 AVERAGE, 411 GRAIN FARMS (NO LIVESTOCK), CENTRAL ILLINOIS

	Corn		Soybeans	
	Average, 1970-1973	1973	Average, 1970-1973	1973
Other costs:				
Labor	$ 17	$ 18	$ 17	$ 18
Building and storage	5	5	3	3
Machinery depreciation	14	15	12	13
Taxes	11	12	11	12
Interest on bare land	34	43	34	43
Non-land interest	12	14	9	11
Overhead	4	5	4	5
TOTAL, OTHER COSTS	$ 97	$112	$ 90	$105
TOTAL, ALL COSTS	$144	$167	$121	$143
TOTAL COST PER BUSHEL	$ 1.16	$ 1.28	$ 2.89	$ 3.57

T2

1972 Ohio Farm Business Analysis Report

CORN ENTERPRISE SUMMARY

	Rank by Family Labor & Management Income per Hour to Corn Enterprise			
	Top 25%	Middle 50%	Lower 25%	My Farm
NUMBER OF FARMS	12	24	11	
GENERAL INFORMATION				
Number of Acres	118	101	56	
Value per bushel produced	$1.33	$1.27	$1.24	
Total Cost per bushel produced	$1.00	$1.33	$1.71	
PER ACRE INFORMATION (The following information is on a per acre basis)	Per acre	Per acre	Per acre	
Bushels Produced	119.2	103.0	87.0	
Productive Man Work Units	.549	.650	.546	
Value of Labor Used	$14.03	$16.50	$13.27	
TOTAL VALUE OF PRODUCTION	$158.48	$130.83	$107.86	

1972 Ohio Farm Business Analysis Report

CORN ENTERPRISE SUMMARY

PER ACRE INFORMATION (The following information is on a per acre basis)	Per acre	Per acre	Per acre	My Farm
Cash Expenses				
Hired Labor	$ 1.81	$ 2.47	$ 1.91	
Farm Supplies	5.85	6.37	6.12	
Machine Repairs	6.92	6.22	7.95	
Build, Fence, Etc.	.26	.34	.18	
Fuel, Oil & Grease	4.48	4.92	4.59	
Utilities (Farm Share)	.81	.60	.37	
Drying & Storage	3.02	.99	1.02	
Misc. Expense	.38	.53	1.21	
Seeds & Plants	7.62	7.15	6.64	
Fertilizer & Line	26.54	28.79	30.41	
Machine Hired Trk.	2.20	1.82	4.63	
Auto Expense	.68	.96	.68	
Interest on Notes	7.32	8.98	14.73	
Taxes	2.65	4.03	5.14	
Rent	8.54	7.57	1.45	
Insurance	.76	1.20	1.18	
Total Cash Expenses	$79.84	$82.94	$88.21	

1972 OHIO FARM BUSINESS ANALYSIS REPORT

CORN ENTERPRISE SUMMARY

	TOP 25% PER ACRE	MIDDLE 50% PER ACRE	LOWER 25% PER ACRE	MY FARM
NON-CASH EXPENSES				
DEPRECIATION				
BLDG., FENCE & TILE	$ 3.18	$ 3.11	$ 2.68	
MACHINERY & EQUIPMENT	9.44	14.59	17.38	______
TOTAL DEPRECIATION	12.62	17.70	20.06	______
UNPAID OPR. AND FAM. LABOR	12.21	14.03	11.36	______
INTEREST NOT CHARGED	14.48	22.23	28.82	______
TOTAL NON-CASH EXPENSES	39.31	53.96	60.24	______
TOTAL EXPENSES OF PRODUCTION	119.15	136.90	148.45	______
MANAGEMENT INCOME AND PROFIT	39.33	-6.07	-40.59	______
VALUE OF PRODUCTION-CASH EXPENSES	78.64	47.89	19.65	______

1972 Ohio Farm Business Analysis Report
CORN ENTERPRISE SUMMARY

	Top 25% Per acre	Middle 50% Per acre	Lower 25% Per acre	My farm
Total Investment	$363.48	$520.17	$726.07	
Return on Investment	61.14	25.13	2.95	
Percent Return on Investment	16.8%	4.8%	.4%	
Return to Unpaid Operator and Family Labor, Management and Profit				
Total Per Acre	$ 51.54	$ 7.95	$-29.23	
Per Hour	$ 11.43	$ 1.52	$ -6.63	
RATIO ANALYSIS				
Profit Margin	.386	.192	.027	
Turnover	.436	.252	.149	
Return on Investment	.168	.048	.004	

1972 Ohio Farm Business Analysis Report

SOYBEAN ENTERPRISE SUMMARY

	Rank by Family Labor & Management Income per Hour to Soybean Enterprise			
	Top 25%	Middle 50%	Lower 25%	My farm
NUMBER OF FARMS	6	12	5	
GENERAL INFORMATION				
Number of Acres	77	94	35	
Value per bushel produced	$4.03	$3.70	$2.83	
Cost per bushel produced	$2.54	$3.10	$5.39	
PER ACRE INFORMATION (The following information is on a per acre basis)	Per acre	Per acre	Per acre	
Bushels produced	38.0	30.7	18.1	
Productive Man Work Units	.464	.660	.374	
Value of Labor Used	$12.68	$17.62	$9.97	
TOTAL VALUE OF PRODUCTION	$153.06	$113.74	$51.14	

1972 OHIO FARM BUSINESS ANALYSIS REPORT

SOYBEAN ENTERPRISE SUMMARY

PER ACRE INFORMATION (THE FOLLOWING INFORMATION IS ON A PER ACRE BASIS)	TOP 25% PER ACRE	MIDDLE 50% PER ACRE	LOWER 25% PER ACRE	MY FARM
CASH EXPENSES				
HIRED LABOR	$ 3.40	$ 1.17	$ .60	______
FARM SUPPLIES	5.10	5.76	3.57	______
MACHINE REPAIRS	8.87	4.04	6.89	______
BUILD, FENCE, ETC.	.13	.63		______
FUEL, OIL & GREASE	3.00	4.11	6.51	______
UTILITIES (FARM SHARE)	1.02	.48	.54	______
DRYING & STORAGE	.34	.21		______
MISC. EXPENSE	.43	.52	.37	______
SEEDS AND PLANTS	4.64	4.16	5.26	______
FERTILIZER AND LIME	5.12	6.94	9.94	______
MACHINE HIRED TRK.	.45	1.50	4.69	______
AUTO EXPENSE	.60	1.10	2.09	______
INTEREST ON NOTES	6.06	8.74	3.37	______
TAXES	2.17	4.23	2.69	______
RENT	16.95	6.61	4.11	______
INSURANCE	1.08	.86	1.46	______
TOTAL CASH EXPENSES	$59.36	$51.06	$52.09	______

1972 OHIO FARM BUSINESS ANALYSIS REPORT

SOYBEAN ENTERPRISE SUMMARY

	TOP 25%	MIDDLE 50%	LOWER 25%	MY FARM
NON-CASH EXPENSES	PER ACRE	PER ACRE	PER ACRE	
DEPRECIATION				
BLDG., FENCE, & TILE	$ 3.84	$ 1.63	$ .71	______
MACHINERY & EQUIP.	8.70	9.12	13.20	______
TOTAL DEPRECIATION	12.54	10.75	13.91	______
UNPAID OPR. AND FAM. LABOR	9.28	16.45	9.37	______
INTEREST NOT CHARGED	15.30	16.89	22.11	______
TOTAL NON-CASH EXPENSES	37.12	44.09	45.39	______
TOTAL EXPENSES OF PRODUCTION	96.48	95.15	97.48	______
MANAGEMENT INCOME AND PROFIT	56.58	18.59	-46.34	______
VALUE OF PRODUCTION - CASH EXPENSES	93.70	62.68	-.95	______

1972 Ohio Farm Business Analysis Report
SOYBEAN ENTERPRISE SUMMARY

	Top 25%	Middle 50%	Lower 25%	My farm
	Per acre	Per acre	Per acre	
Total Investment	$356.25	$427.23	$424.89	______
Return on Investment	77.94	44.22	-20.86	______
Percent Return on Investment	21.9%	10.4%	-4.9%	______
Return to Unpaid Operator and Family Labor, Management and Profit				
Total Per Acre	$ 65.86	$ 35.05	$-36.97	______
Per Hour	$ 22.24	$ 5.84	$-10.69	______
RATIO ANALYSIS				
Profit Margin	.509	.389	-.408	______
Turnover	.430	.266	.120	______
Return on Investment	.219	.104	-.049	______

CORN ENTERPRISE SUMMARY

		RANK BY FAMILY LABOR & MANAGEMENT INCOME PER HOUR TO CORN ENTERPRISE			
	UNIT	TOP 25% PER ACRE	MIDDLE 50% PER ACRE	LOWER 25% PER ACRE	MY FARM
TOTAL VALUE OF PRODUCTION	$	271.84	183.26	194.41	______
CASH EXPENSES					
HIRED LABOR	$	3.47	1.76	1.24	______
FARM SUPPLIES	$	11.11	6.44	9.11	______
MACHINE REPAIRS	$	7.63	6.90	9.14	______
BUILD, FENCE, ETC.	$	.66	.57	1.49	______
FUEL, OIL & GREASE	$	6.58	6.34	6.68	______
UTILITIES (FARM SHARE)	$	1.26	.88	.74	______
DRYING & STORAGE	$	4.32	2.72	2.88	______
MISC. EXPENSE	$	.90	1.22	1.19	______
SEEDS & PLANTS	$	10.20	8.70	8.88	______
FERTILIZER & LIME	$	32.41	28.08	37.74	______
MACHINE HIRED TRK.	$	1.19	3.20	2.13	______
AUTO EXPENSE	$	.76	.82	.92	______
INTEREST ON NOTES	$	9.63	10.82	14.30	______
TAXES	$	3.26	3.91	4.11	______
RENT	$	17.63	9.37	12.09	______
INSURANCE	$	1.61	1.78	2.35	______
TOTAL CASH EXPENSES	$	112.62	93.51	114.99	______

T11

1973 Ohio Farm Business Analysis Report

CORN ENTERPRISE SUMMARY

	Unit	Rank by Family Labor & Management Income Per Hour to Corn Enterprise			
		Top 25% Per Acre	Middle 50% Per Acre	Lower 25% Per Acre	My farm
Non-Cash Expenses					
Depreciation					
Bldg., Fence & Tile	$	4.16	3.54	2.78	
Machinery & Equipment	$	13.08	17.84	19.58	
Total Depreciation	$	17.24	21.38	22.36	
Unpaid Opr. and Fam. Labor	$	11.21	15.77	18.52	
Interest Not Charged	$	18.03	18.01	20.07	
Total Non-Cash Expenses	$	46.48	55.16	60.95	
TOTAL EXPENSES OF PRODUCTION	$	159.10	148.67	175.94	

1973 OHIO FARM BUSINESS ANALYSIS REPORT

CORN ENTERPRISE SUMMARY

		RANK BY FAMILY LABOR & MANAGEMENT INCOME PER HOUR TO CORN ENTERPRISE			
	UNIT	TOP 25% PER ACRE	MIDDLE 50% PER ACRE	LOWER 25% PER ACRE	MY FARM
MANAGEMENT INCOME AND PROFIT	$	112.74	34.59	18.47	______
VALUE OF PRODUCTION MINUS CASH EXPENSES	$	159.22	89.75	79.42	______
RETURN TO UNPAID OPERATOR AND FAMILY LABOR, MANAGEMENT AND PROFIT					
TOTAL PER ACRE	$	123.95	50.36	36.99	______
PER HOUR	$	32.15	9.13	6.18	______

1973 OHIO FARM BUSINESS ANALYSIS REPORT
CORN ENTERPRISE SUMMARY

	UNIT	TOP 25%	MIDDLE 50%	LOWER 25%	MY FARM
NUMBER OF FARMS		16	32	16	
GENERAL INFORMATION					
NUMBER OF ACRES	A.	138	101	104	______
VALUE PER BUSHEL PRODUCED	$	2.63	2.16	2.06	______
TOTAL COST PER BUSHEL PRODUCED	$	1.54	1.75	1.86	______
RATIO ANALYSIS					
PROFIT MARGIN	%	51.7	34.6	27.2	______
TURNOVER	$/$	.59	.38	.34	______
RETURN ON INVESTMENT	%	30.5	13.2	9.2	______

T14

1973 OHIO FARM BUSINESS ANALYSIS REPORT
CORN ENTERPRISE SUMMARY

PER ACRE INFORMATION	UNIT	TOP 25% PER ACRE	MIDDLE 50% PER ACRE	LOWER 25% PER ACRE	MY FARM
BUSHELS PRODUCED	BU.	103.4	84.8	94.5	______
PRODUCTIVE MAN WORK UNITS	NO.	.548	.636	.644	______
VALUE OF LABOR USED	$	14.68	17.53	19.76	______
TOTAL INVESTMENT	$	461.05	480.60	572.78	______
RETURN ON INVESTMENT	$	140.40	63.42	52.84	______
PERCENT RETURN ON INVESTMENT	%	30.5	13.2	9.2	______

SOYBEAN ENTERPRISE SUMMARY

		Rank by Family Labor & Management Income Per Hour to Soybean Enterprise			
	Unit	Top 25% Per Acre	Middle 50% Per Acre	Lower 25% Per Acre	My farm
TOTAL VALUE OF PRODUCTION	$	197.67	149.45	140.50	______
Cash Expenses					
Hired Labor	$	1.73	1.22	2.84	______
Farm Supplies	$	6.40	7.31	3.32	______
Machine Repairs	$	8.07	6.38	9.70	______
Build, Fence, Etc.	$	.28	.62	.71	______
Fuel, Oil & Grease	$	6.13	5.04	5.64	______
Utilities (Farm Share)	$	.41	.62	.39	______
Drying & Storage	$	.23	.17	.72	______
Misc. Expense	$	1.73	1.13	.60	______
Seeds & Plants	$	8.26	9.29	8.89	______
Fertilizer & Lime	$	7.46	6.71	14.22	______
Machine Hired Trk.	$	1.31	.82	1.93	______
Auto Expense	$	.46	1.27	.79	______
Interest on Notes	$	7.46	9.00	7.15	______
Taxes	$	4.29	2.32	2.76	______
Rent	$	12.87	15.29	8.25	______
Insurance	$	2.15	1.62	1.40	______
Total Cash Expenses	$	69.24	68.81	69.31	______

SOYBEAN ENTERPRISE SUMMARY

		Rank by Family Labor & Management Income Per Hour to Soybean Enterprise			
	Unit	Top 25%	Middle 50%	Lower 25%	My farm
		Per Acre	Per Acre	Per Acre	
Non-Cash Expenses					
Depreciation					
Bldg., Fence & Tile	$	2.32	2.40	2.93	______
Machinery & Equip.	$	11.97	10.05	13.31	______
Total Depreciation	$	14.29	12.45	16.24	______
Unpaid Opr. and Fam. Labor	$	8.89	14.02	9.83	______
Interest Not Charged	$	18.22	10.43	20.56	______
Total Non-Cash Expenses	$	41.40	36.90	46.63	______
TOTAL EXPENSES OF PRODUCTION	$	110.64	105.71	115.94	______

SOYBEAN ENTERPRISE SUMMARY

		Rank by Family Labor & Management Income Per Hour to Soybean Enterprise			
	Unit	Top 25% Per Acre	Middle 50% Per Acre	Lower 25% Per Acre	My farm
Management Income and Profit	$	87.03	43.74	24.56	______
Value of Production minus Cash Expenses	$	128.43	80.64	71.19	______
Return to Unpaid Operator and Family Labor, Management and Profit					
Total Per Acre	$	95.92	57.76	34.39	______
Per Hour	$	33.72	12.17	10.58	______

SOYBEAN ENTERPRISE SUMMARY

	UNIT	TOP 25%	MIDDLE 50%	LOWER 25%	MY FARM
NUMBER OF FARMS		12	24	12	
GENERAL INFORMATION					
Number of Acres	A.	156	125	108	______
Value Per Bushel Produced	$	5.59	5.57	5.20	______
Total Cost Per Bushel Produced	$	3.13	3.94	4.29	______
RATIO ANALYSIS					
Profit Margin	%	57.0	42.3	37.2	______
Turnover	$/$	.46	.46	.30	______
Return on Investment	%	26.3	19.5	11.3	______

SOYBEAN ENTERPRISE SUMMARY

PER ACRE INFORMATION	UNIT	TOP 25% PER ACRE	MIDDLE 50% PER ACRE	LOWER 25% PER ACRE	MY FARM
BUSHELS PRODUCED	Bu.	35.4	26.8	27.0	______
PRODUCTIVE MAN WORK UNITS	No.	.384	.519	.444	______
VALUE OF LABOR USED	$	10.62	15.24	12.67	______
TOTAL INVESTMENT	$	427.95	323.87	461.93	______
RETURN ON INVESTMENT	$	112.71	63.16	52.27	______
PERCENT RETURN ON INVESTMENT	%	26.3	19.5	11.3	______

PRELIMINARY BUDGET FOR CORN PRODUCTION, 1975

ITEM	YOUR FIGURES
OPERATING INPUTS	
SEED	________
FERTILIZER	________
SPRAY	________
CROP INSURANCE	________
SUPPLIES, MISCELLANEOUS, SOIL TESTING, PLANT ANALYSIS, DUES, OPERATORS WORKMEN'S COMPENSATION, ETC.	________
INTEREST ON OPERATING CAPITAL $ x .10 x 7 MO.	________
FIELD OPERATIONS [3]	
LAND	________
ESTIMATED ADDITIONAL OPERATING LABOR	________
CHARGE FOR MANAGEMENT, 10%	________
TOTAL	________
PROFIT OR (LOSS)	________

T21

PRELIMINARY BUDGET FOR SOYBEANS, 1975

ITEM	YOUR FIGURES
Operating Inputs	
Seed	
Fertilizer	
Spray	
Crop Insurance	
Supplies, Miscellaneous, Soil Testing, Plant Analysis, Dues, Operators Workmen's Compensation, etc.	
Interest on Operating Capital $ x .10 x 6 mo.	
Field Operations[3]	
Land	
Estimated Additional Operating Labor	
Charge for Management, 10%	
Total	
Profit or (loss)	

CORN

BU./A	PRICE/BU.		
	$2.60	$3.00	$3.40
80	9	41	73
110	46	90	134
140	77	133	189

T23

SOYBEANS

BU./A.	PRICE/BU.		
	$5.50	$6.50	$7.50
25	(13)	11	36
35	21	56	91
45	55	100	145

PLANNING CROP ROTATION

Crops	ALT. 1		
	Acres	(1) Your Est. Profit/A.	Total Est. Profit
TOTAL		XXXXXXXXX	

(1) Use Work Sheets for crops, adjusted for your farm

Adult Unit No. 20

PLANNING AND GROWING A HOME VEGETABLE GARDEN

A Resource Unit For Adult Education
Classes in Agriculture

Developed by
Mike Hampson

Edited by
L. H. Newcomb

Department of Agricultural Education
College of Agriculture and Home Economics
The Ohio State University
Columbus, Ohio 43210

1975

-- 606

PREFACE

THIS RESOURCE UNIT WAS DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U. S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN
ASSISTANT PROFESSOR

L. H. NEWCOMB
ASSISTANT PROFESSOR

607

CONTENT SUMMARY

PAGE

Preface III

Introduction 1

National and State Situation 3

Local Situation 3

Objectives 3

References 4

Needed AV Equipment 4

Alternative Interest Approaches 4

Questions to be Answered 5

Learning Activities 5

To Summarize (note to teacher) 8

Application 8

Appendix A: Content Summary 9

Appendix B: Instructional Materials 11

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

609

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR *TEACHER USE ONLY*. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATIBLE TO THE LOCAL COMMUNITY.

PLANNING AND GROWING A HOME
VEGETABLE GARDEN

NATIONAL AND STATE SITUATION

THE GENERAL PUBLIC IS SHOWING MUCH INTEREST IN HOME VEGETABLE GARDENING. INCREASED SALES OF VEGETABLE SEED, GARDENING SUPPLIES, EQUIPMENT, AND HOME CANNING MATERIALS, PLUS SKYROCKETING DEMAND FOR GARDENING LITERATURE, BOOKS, EXTENSION BULLETINS, LEAFLETS, SEED CATALOGS, AND PERIODICALS ALL INDICATE THIS INTEREST WILL GROW.

MORE VEGETABLE GARDENING ARTICLES ARE APPEARING IN NEWSPAPERS, MAGAZINES, AND THE MASS MEDIA. COUNTY AND AREA EXTENSION AGENTS, AND OTHER EDUCATORS, AND ORGANIZATIONAL OFFICIALS ARE SEEKING MORE ASSISTANCE FROM SPECIALISTS. MORE LAND AREA, INCLUDING LAWNS, IS BEING DIVERTED TO GARDENING ACTIVITIES. INTEREST HAS BEEN RENEWED IN COMMUNITY AND SCHOOL GARDEN PLOTS FOR INDIVIDUAL AND FAMILY GARDENING ACTIVITIES. THESE THINGS ALL POINT TO TREMENDOUS INTEREST IN VEGETABLE GARDENING.

WHY ALL OF THIS RENEWED INTEREST? BASICALLY IT IS ECONOMICS, BUDGET, AND THE FULFILLMENT OF HUMAN WANTS AND DESIRES.

EVERYONE IS ACUTELY AWARE OF RISING PRICES. FOOD COSTS ARE PARTICULARLY NOTICEABLE BECAUSE EVERYONE HAS TO EAT AND FOOD IS PURCHASED REGULARLY ON A DAY TO DAY BASIS. AND, WITHOUT FRUITS AND VEGETABLES, OUR DIETS WOULD NOT ONLY BECOME MONOTONOUS BUT ALSO LACKING IN NUTRITIONAL QUALITIES.

FOR MANY, HOWEVER, THE PRIMARY VALUE OF THE GARDEN MAY NOT BE IN THE SAVINGS IT MIGHT BRING TO THE FAMILY FOOD BUDGET, BUT ALSO FOR THE SATISFACTION IT BRINGS IN A SUCCESSFUL CROP. OFTEN, PERSONAL SATISFACTION AND ECONOMIC SUCCESS GO TOGETHER.

LOCAL SITUATION

DETERMINE THE PERCENTAGE (ROUGH) OF PEOPLE IN YOUR COMMUNITY WHO HAVE GARDENS. ALSO BECOME FAMILIAR WITH CROPS GROWN, PLANTING DATES, AND CULTURAL PRACTICES.

OBJECTIVES

AT THE COMPLETION OF THIS UNIT THE ADULT SHOULD BE ABLE TO:

1. PLAN THE LAYOUT FOR HIS GARDEN.
2. SELECT A SITE FOR HIS GARDEN.
3. PREPARE THE SOIL FOR PLANTING.

611

4. Select seeds and plants that will be grown in his garden.

5. List three methods of weed control.

6. List a method of insect control.

7. Plant his garden and properly care for it until maturity.

References

Brooks, William M.; Utzinger, James D.; and Wittmeyer, E. C. *Vegetable Varieties for Ohio Home Gardens*. The Ohio Cooperative Extension Service, The Ohio State University; Bulletin L-100, 1975. (Available in each County Extension Office.)

Home Vegetable Gardening Handbook. The Ohio Cooperative Extension Service, The Ohio State University; Bulletin 287, 1975. (Available in each County Extension Office.)

Home Vegetable Garden Insect Control. The Ohio Cooperative Extension Service, The Ohio State University; Bulletin 498, January, 1975. (Available in each County Extension Office.)

Home Vegetable Gardening. Slide Series. The Ohio Cooperative Extension Service, The Ohio State University. (Available in each County Extension Office.)

New Garden Book. Better Homes and Gardens. Second Edition. DeMoines, Iowa: Meredith Corporation, 1968.

Utzinger, James D. *Producing Horticultural Plants from Seed*. The Ohio Cooperative Extension Service, The Ohio State University.

Needed AV Equipment

Chalkboard, overhead projector, screen, slide projector, and cassette tape recorder.

Alternative Interest Approaches

Alternative A. Hold a group discussion comparing processed, store bought, and fresh vegetables emphasizing *price* and quality.

Alternative B. Conduct a discussion and attempt to create doubt and uncertainty concerning planting times and cultural practices.

Alternative C. Discuss how the joys of gardening are available to everyone. Point out how the garden can be used not only as a source of food but also for a family activity, a teaching vehicle, competition among neighbors, exercise, and fresh air or simply a relaxing hobby.

Alternative D. Show slides (if available) of some exceptional gardens in the community.

Questions to be Answered

1. Where can we obtain information about vegetable gardening?
2. How do I plan what and how much to put in my garden?
3. What vegetables can we grow and when do we plant them?
4. Where can we put a garden and how do we arrange it?
5. How do we plant a garden?
6. How do we prepare the soil for planting?
7. What equipment and supplies are needed?
8. How do we control weeds and insects? How do we find up-to-date information on insect control?

Learning Activities

1. Where can we obtain information about vegetable gardening?

Have gardener participants disucss various sources of information they utilize. List various responses on the board. Bring out such responses as:

1. Friends, neighbors, and relatives
2. Greenhouse owners
3. County extension agent
4. Vocational Agriculture teachers
5. Library
6. Horticulture Hot Line (1-614-469-5595)

2. How do I plan what and how much to put in my garden?

Open the discussion of garden planning by showing transparencies #1 and 2. Point out the necessity of planning a garden according to the family's needs. The plan should include kind and amount of vegetables to be planted, crop planting dates, planting location, and distance between rows.

Have each member draw up a garden plan for his family.

3. WHAT VEGETABLES CAN WE GROW AND WHEN DO WE PLANT THEM?

DISCUSS THE CHART ON PAGE 8 OF THE OHIO COOPERATIVE EXTENSION SERVICE BULLETIN 287. DEFINE WARM SEASON AND COOL SEASON CROPS AND DISCUSS EXAMPLES WITH CLASS MEMBERS. DISCUSS THE DIFFERENCE BETWEEN SUCCESSION CROPS AND COMPANION CROPS AND LIST EXAMPLES ON THE BOARD.

HAVE GARDENER PARTICIPANTS RELATE WHICH VEGETABLES THEY GROW FROM SEED AND WHICH FROM PLANTS. CITE EXAMPLES OF VEGETABLES STARTED FROM SEEDS AND VEGETABLES STARTED FROM PLANTS.

PASS OUT AND GO OVER HANDOUT #1, PRODUCING HORTICULTURE PLANTS FROM SEED, UNDER "INSTRUCTIONAL MATERIALS." GIVE DEMONSTRATION OF THE STEPS IN STARTING SEED.

ASK GARDENER MEMBERS TO RELATE THEIR EXPERIENCES WITH VARIOUS VARIETIES. PASS OUT COOPERATIVE EXTENSION SERVICE BULLETIN L-100, HOME VEGETABLE VARIETIES FOR OHIO GARDENS. DISCUSS VARIETY SELECTION BASED ON PAST EXPERIENCE, INTENDED USE, MATURITY RANGE, AND DISEASE RESISTANCE.

4. WHERE CAN WE PUT A GARDEN AND HOW DO WE ARRANGE IT?

SHOW SLIDE/SOUND PRESENTATION, HOME VEGETABLE GARDENING. REFER TO EACH OF THE MAIN POINTS OF THE PRESENTATION WHEN DISCUSSING THE APPLICABLE QUESTIONS TO BE ANSWERED. (AVAILABLE AT YOUR LOCAL COUNTY EXTENSION OFFICE.)

DISCUSS THE SUBHEADINGS, LOCATION AND SOILS, IN OHIO COOPERATIVE EXTENSION SERVICE BULLETIN 287 FOUND IN THE "CONTENT SUMMARY." LIST ON THE BOARD THE FACTORS TO BE CONSIDERED IN GARDEN LOCATION AND ARRANGEMENT.

5. HOW DO WE PLANT A GARDEN?

DISCUSS PLANTING DEPTH USING TRANSPARENCY #10. POINT OUT IN THE DISCUSSION PROPER WATERING PROCEDURE, SEED TO SOIL CONTACT, AND SEED SPACING.

CONTINUE BY DISCUSSING TRANSPLANTING AND HARDENING PLANTS.

6. HOW DO WE PREPARE THE SOIL FOR PLANTING?

USE TRANSPARENCY #3 TO DISCUSS PH SCALE, AND POINT OUT THAT MORE NUTRIENTS ARE AVAILABLE FOR MOST VEGETABLES AT A PH OF BETWEEN 5.8 AND 6.8. CONTINUE THE DISCUSSION BY EXPLAINING THE AVAILABILITY OF SOIL TESTING THROUGH THE OFFICE OF THE LOCAL COUNTY EXTENSION AGENT.

USE TRANSPARENCIES #4 AND 5 TO DISCUSS FERTILIZER ANALYSIS. DISCUSS WHAT EACH NUMBER REFERS TO AND HOW EACH PROMOTES PLANT GROWTH.

DISCUSS ORGANIC FERTILIZERS USING TRANSPARENCY #6. ASK GARDENER PARTICIPANTS TO MENTION TYPES OF ORGANIC FERTILIZER THAT THEY USE. CAUTION THE GROUP ON USING MORE THAN 10 POUNDS OF RABBIT OR CHICKEN MANURE

614

PER 100 SQUARE FEET OF GARDEN AREA AS THESE ORGANICS CAN BURN CROPS DUE TO THEIR HIGH NITROGEN CONTENT.

CONTINUE THE DISCUSSION BY USING TRANSPARENCY #7 TO EXPLAIN THE USE OF STARTER SOLUTIONS AND SIDE DRESSINGS. CAUTION THE GROUP NOT TO USE FERTILIZERS CONTAINING HERBICIDES IN THE HOME GARDEN.

DISCUSS THE PROPER TIME TO WORK THE SOIL TO AVOID CRUSTING AND SOIL COMPACTION.

HAVE EACH CLASS MEMBER CONTINUE WORK ON THE GARDEN PLAN AND WRITE A JOB PLAN FOR THE FERTILIZER THAT THEY ARE PLANNING TO USE (WHAT KIND, HOW MUCH TO APPLY, WHAT COST, AND WHERE TO PURCHASE).

7. WHAT EQUIPMENT AND SUPPLIES ARE NEEDED?

THE GARDENER MUST MAKE PROVISIONS FOR THE FOLLOWING GARDEN OPERATIONS (TRANSPARENCY #8):

1) SOIL PREPARATION INCLUDING CONDITIONING TO MODIFY UNDESIRABLE SOIL STRUCTURES. CLAYEY SOILS CAN BE IMPROVED BY ADDING HUMUS (ORGANIC MATTER).

2) MAINTAINING OR INCREASING SOIL FERTILITY.

3) PROPER PLANTING AND THINNING OF CROPS WHEN NECESSARY.

4) CONTROLLING WEEDS.

5) PREVENTING INSECTS AND DISEASE DAMAGE OF PLANTS AND SAFETY TO THE GARDENER AND OTHER INDIVIDUALS.

6) MAINTAINING ADEQUATE SOIL MOISTURE.

DISCUSS WHAT TOOLS AND SUPPLIES ARE NEEDED TO ACCOMPLISH THESE JOBS. POINT OUT THAT THE MINIMUM TOOLS NEEDED ARE (TRANSPARENCY #9):

1) SPADING FORK

2) HOE

3) RAKE

4) TROWEL

5) POINTED STAKES AND STRING FOR LAYING OUT ROWS

8. HOW DO WE CONTROL WEEDS AND INSECTS?

USING TRANSPARENCIES #10 AND 11 DISCUSS WITH GARDENER PARTICIPANTS THE VARIOUS WAYS THAT THEY CONTROL WEEDS. LIST THE ADVANTAGES AND DISADVANTAGES OF ORGANIC MULCH, PLASTIC FILM, CULTIVATION, AND CHEMICALS. HAVE THE CLASS EXAMINE SAMPLES OF EACH TYPE OF MATERIAL USED FOR CONTROLLING WEEDS.

HOW DO WE FIND UP-TO-DATE INFORMATION ON INSECT CONTROL?

DISCUSS THE USE OF HOME VEGETABLE GARDEN INSECT CONTROL, BULLETIN 498. STRESS THE IMPORTANCE OF OBTAINING A NEW BULLETIN EACH YEAR FOR UP-TO-DATE REGISTERED USES OF PESTICIDES.

FOLLOW-UP THE DISCUSSION BY DEMONSTRATING THE PROPER MIXING, APPLICATION, AND DISPOSAL OF INSECTICIDES.

TO SUMMARIZE (NOTE TO TEACHER)

WHILE THERE IS TECHNICAL INFORMATION REGARDING VEGETABLE GARDENING, THERE ARE SEVERAL OTHER KEYS TO SUCCESSFUL HOME VEGETABLE GARDENING WHICH SHOULD BE POINTED OUT. THESE OTHER KEYS ARE DESIRE, AMBITION, FAVORABLE WEATHER, AND DEVOTED EFFORT. THESE KEY INGREDIENTS WILL SEPARATE THE GOOD GARDENER FROM THE POOR GARDENER; THE GARDENER WHO SAVES MONEY AND RECEIVES PERSONAL SATISFACTION FROM THE GARDENER WHO HAS UNPRODUCTIVELY INVESTED HIS MONEY AND ONLY REAPS FRUSTRATION.

APPLICATION

A. USE SUPERVISORY VISITS TO EVALUATE APPLICATION OF APPROVED PRACTICES (TRANSPARENCY #10).

B. GROW TEST PLOTS IN THE COMMUNITY TO DEMONSTRATE:

1. OPTIMUM PLANTING DATES OF DIFFERENT VEGETABLES.
2. HIGH YIELDING VARIETIES.
3. IDEAL PLANTING DEPTHS.
4. OPTIMUM ROW WIDTH AND SPACING.
5. ADVANTAGES AND DISADVANTAGES OF DIFFERENT TYPES OF WEED CONTROL MEASURES.
6. ADVANTAGES AND DISADVANTAGES OF VARIOUS INSECTICIDES.

APPENDIX A

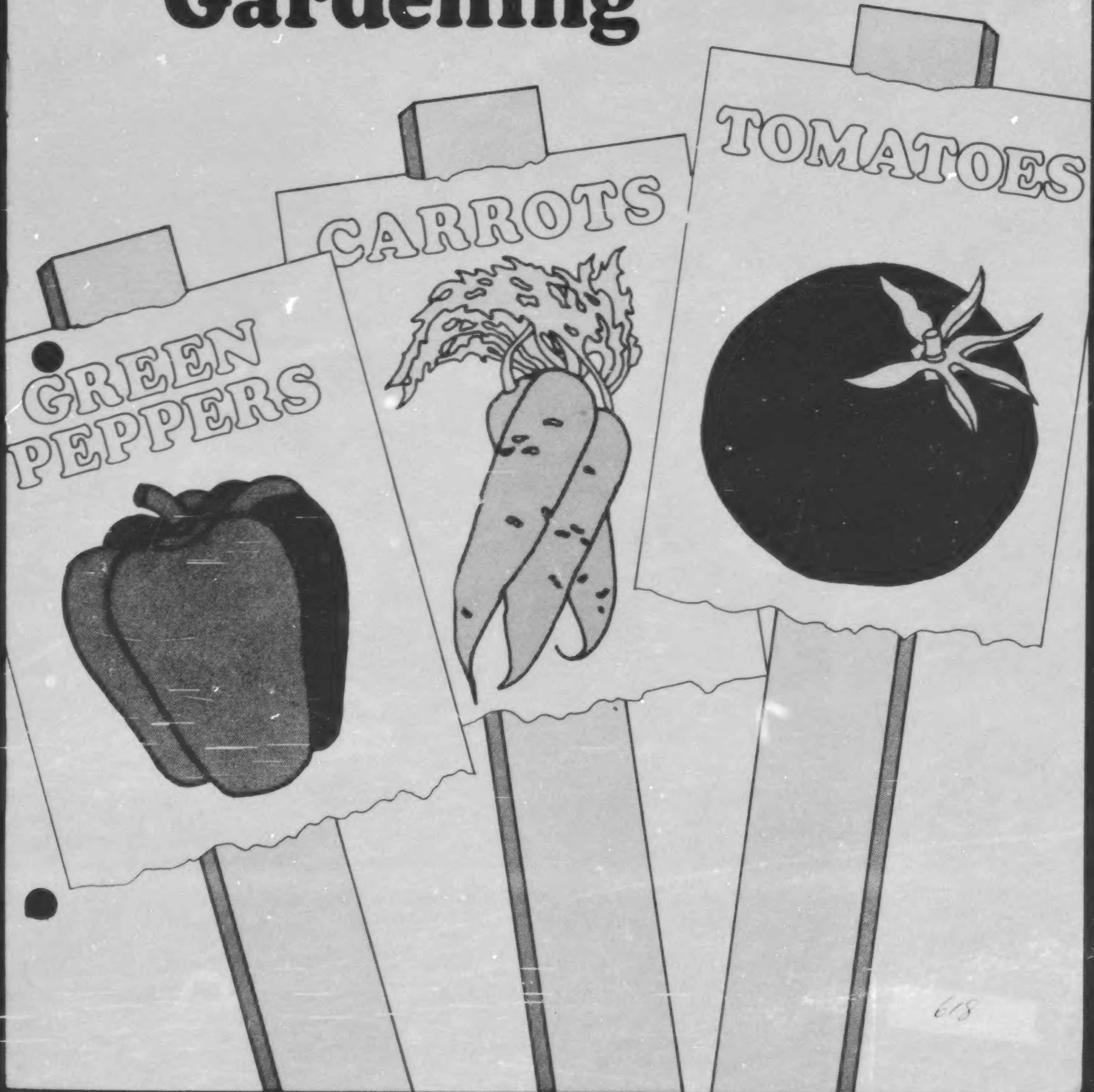
CONTENT SUMMARY

HOME VEGETABLE GARDENING, BULLETIN 287

617

Bulletin 287
Cooperative Extension Service
The Ohio State University

Home Vegetable Gardening


GREEN PEPPERS
CARROTS
TOMATOES

CONTENTS

Planning for the Garden 3
- Why have a garden?
- Location
- Soils
- Preparing a plan
- What to grow
- Vegetable needs for family
- Succession planting
- Tools and supplies

Production Procedure 7
- Recommended cultivars and hybrids
- Planting time
- Vegetables seeded directly
- Vegetables started from plants
- Cultural practices

Soil Improvement 11
- Liming
- Fertilizing
- Starter solutions
- Side dressing

Seeding and Planting 13
- Seedbed preparation
- Obtaining plants
- Seed
- Establishing the plants
- Transplanting

Weed Control 15
- Organic mulches
- Plastic film
- Cultivation
- Chemicals

Watering 17

Cultural Suggestions 17

Vegetable Storage 21

Insect and Disease Control 21

Gardening vocabulary 21

Common gardening problems 23

AUTHORS

J. D. UTZINGER
W. M. BROOKS
E. C. WITTMEYER
Extension Horticulturists
The Ohio State University

Edited and illustrated by

Roudell Byrd and **Marlynda Bennett**
Extension Service, Office of Information

ACKNOWLEDGEMENTS

The authors express appreciation to Evelyn Gray, Extension Nutritionist, The Ohio State University, for contributing the home economics information in this bulletin, particularly Tables 1 and 2.

619

4/75—15M (Reprint)

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Roy M. Kottman, Director of the Cooperative Extension Service, The Ohio State University.

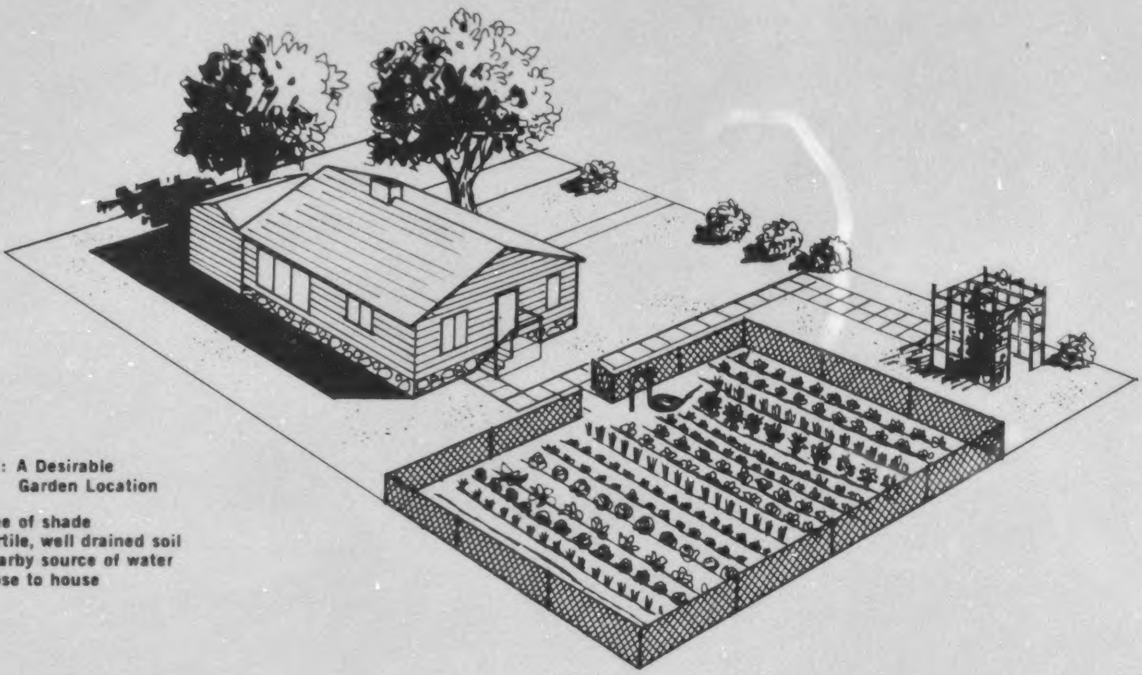


Fig. 1: A Desirable Garden Location

1. **Free of shade**
2. **Fertile, well drained soil**
3. **Nearby source of water**
4. **Close to house**

Planning for the Garden

Why Have A Garden?

Vegetables constitute an important part of the human diet. Millions of Americans produce vegetables through home gardening activities each season. With a small amount of land, a few basic tools and supplies, and a desire to assist nature in plant growth, the gardener can realize many benefits from gardening activities. A well planned and a properly cared for garden can provide considerable food for family use from a small plot of land. Most home gardeners agree that "home grown" vegetables, freshly harvested, prepared, and eaten are the ultimate in fine vegetable flavor.

Surplus vegetables not used as fresh products can be preserved by freezing, canning, or storing for later use. Regardless of how you use them—fresh or preserved—home grown vegetables can help reduce family expenditures for food and make a valuable contribution to family nutrition.

Since many different vegetables are grown in Ohio, vegetable gardening can be an educational activity for all members of the family. Youth find vegetable gardening an excellent 4-H Club project. Older, more experienced gardeners enjoy comparing new cultivars with older, proven cultivars and they like to try new ways of growing and using vegetables. Gardening also offers friendly competition among neighbors in such activities as harvesting the first ripe tomato, growing the largest tomato, squash, head of cabbage, or having the most unusual vegetable in the garden.

Good gardening results can be shared with others through vegetable exhibits at local or state fairs. Gardeners find this activity exciting and challenging.

The potential benefits of home vegetable gardening are numerous. Successful gardens are the result of good planning, management, and careful workmanship. This bulletin will assist the gardener in learning more about the various activities required for a successful home vegetable garden.

Location

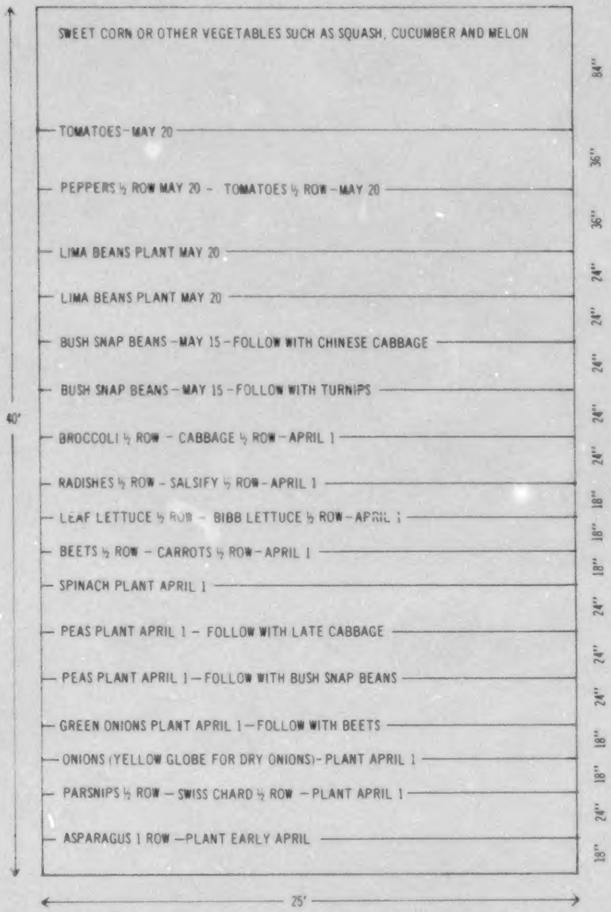
One important way to promote better plant growth is to select a good location for the garden. Such a location provides adequate plant exposure to sunlight, fertile and well-drained soil, a nearby source of water, is close to the house, and is appropriate to the service area of the home landscape.

Vegetable plants make best growth when exposed to direct sunlight for at least 8 to 10 hours a day. Plants growing in heavily shaded areas tend to grow tall and spindly with weak stems and small leaves and produce very little harvest. Plants that receive adequate exposure to sunlight are stocky and sturdy with strong stems and leaves when other growing conditions are favorable for growth. So, it is very important to locate the garden away from heavily shaded areas even though the soil in a sunny area may be poorer than the soil in the shaded area. Modern fertilizers and soil conditioners enable the gardener to improve soil and take advantage of the desirable sunny location.

If at all possible, locate the garden close to the house. Then the gardener can check it often as well as get in a few minutes of work as they become available during the day.

Once you have established the garden in a good location, keep it there for a period of years to permit soil improvement in tilth and fertility. However, the location of the various crops in the garden should be changed from year to year. If enough land is available, the garden crops may be alternated between two plots. Soil improving crops such as rye or rye grass can be grown in alternate

SAMPLE FAMILY VEGETABLE GARDEN PLAN
(To be used as guide for your specific needs)


SWEET CORN OR OTHER VEGETABLES SUCH AS SQUASH, CUCUMBER AND MELON
TOMATOES–MAY 20
PEPPERS ½ ROW MAY 20 – TOMATOES ½ ROW–MAY 20
LIMA BEANS PLANT MAY 20
LIMA BEANS PLANT MAY 20
BUSH SNAP BEANS–MAY 15–FOLLOW WITH CHINESE CABBAGE
BUSH SNAP BEANS–MAY 15–FOLLOW WITH TURNIPS
BROCCOLI ½ ROW – CABBAGE ½ ROW–APRIL 1
RADISHES ½ ROW – SALSIFY ½ ROW–APRIL 1
LEAF LETTUCE ½ ROW – BIBB LETTUCE ½ ROW–APRIL 1
BEETS ½ ROW – CARROTS ½ ROW–APRIL 1
SPINACH PLANT APRIL 1
PEAS PLANT APRIL 1 – FOLLOW WITH LATE CABBAGE
PEAS PLANT APRIL 1–FOLLOW WITH BUSH SNAP BEANS
GREEN ONIONS PLANT APRIL 1–FOLLOW WITH BEETS
ONIONS (YELLOW GLOBE FOR DRY ONIONS)–PLANT APRIL 1
PARSNIPS ½ ROW – SWISS CHARD ½ ROW – PLANT APRIL 1
ASPARAGUS 1 ROW –PLANT EARLY APRIL
84"
36"
36"
24"
24"
24"
24"
24"
18"
18"
18"
24"
24"
24"
18"
18"
24"
18"
40'
25'

years to increase the supply of soil organic matter and improve the tilth or workability of the soil.

Soil fertility cannot be maintained where erosion is severe. Since gardens are cultivated intensively every year, there is little opportunity for protection against soil losses. If possible, avoid slopes where erosion is a problem.

Since soil moisture is often a limiting factor in vegetable production, locate the garden near a source of water. An available source of moisture is necessary for fast seed germination, quick establishment of transplanted crops, and the continuous growth of the plants during dry periods.

Be sure that the garden is located away from trees or shrubs whose roots will compete with the vegetable plants for water and plant nutrients. It is also important to locate the garden away from walnut trees, because these trees secrete a substance through the roots which is injurious to certain vegetables, especially tomatoes.

Soils

Vegetable plants grow best in a fertile, well-drained soil of loamy texture. Sandy loam soils well supplied with organic matter are easily worked. However, most gardeners do not have such soil. Very coarse, sandy soils dry out rapidly and are difficult to keep fertile. Clay soils are difficult to work and usually remain wet until late in the spring. These soils are most often yellow in color and very sticky when wet. They tend to form a hard crust after a heavy rain and become compacted to an extent that the plant's root system is deprived of the essential air required for healthy growth. Clay soils and sand must be modified with soil conditioners such as peat moss, compost, sawdust, or other available organic material. This aspect of garden preparation must not be overlooked.

Preparing A Garden Plan

A well-planned and cared for vegetable garden can provide fresh vegetables for family use from early May until late November. It is best to plan the garden on paper prior to the planting season. The plan should contain information concerning the kind and amount of vegetables to be planted, crop planting dates, planting locations, and the distance between rows. Such a plan provides for the desired amount of each vegetable and aids the gardener in buying the proper amount of seed and plants. The plan is also a handy guide in making succession plantings during the gardening season.

In preparing the plan, make a sketch of the garden area showing the dimensions of the garden. Draw the sketch to scale allowing for as much detail as possible on the plan. Prepare a list of vegetables which you want to grow. In addition to including vegetables which the family enjoys, the gardener may want to plant (on a trial basis) some vegetables never previously grown in the family garden. For a change, it can be interesting and educational to watch the development of crops other than those normally planted in the garden. Too, the family may discover new and enjoyable vegetables which they have not known before. After deciding the kinds of vegetables to grow, determine how many vegetables of each kind the family can use. Plan for enough vegetables to supply the family needs for fresh, frozen, or canned use. Vegetables planted in July and early August produce vegetables which can be stored for winter use. Be realistic in planning garden size so the garden will not become a burden to the family or a weed patch in the community, see Tables 1-4.

Decide where each crop will be grown in the garden plot. Draw in the vegetable rows and label each with the crop and planting date. Indicate the distance between rows and the crops to be used as succession crops.

Use your completed plan in ordering seeds and plants and as a planting guide when the weather becomes favorable for gardening.

What to Grow

Some 40 different vegetable crops can be grown in Ohio, see Tables 3 and 4. The choice of crops depends largely upon the needs and tastes of the family and the amount of available growing space. If space is limited, consider for planting those crops which will be most productive.

Crops such as beans, beets, broccoli, cabbage, carrots, Swiss chard, lettuce, onions, spinach, peppers, radishes, bush type squash, staked tomatoes, and turnips can produce large amounts of food in a relatively small amount of space. Sweet corn and vine crops such as melons, cucumbers, pumpkins, and vining type squash require larger areas for growing. Vine crops in a small area do not make the most productive use of the space. However,

Table 1: Vegetable Needs for Family Members

Sex-Age Group	Kinds of Vegetables and Amounts Per Person for 1 Year				
	Dried Beans, Peas, Nuts (lbs.)	Potatoes (lbs.)	Dark Green and Deep Yellow (lbs.)	Tomatoes and Citrus Fruit (lbs.)	Other Vegetables and Fruits (lbs.)
Children					
7 months to 1 year	0	26	13	78	78
1 to 3 years	3¼	39	13	78	143
3 to 6 years	3¼	52	13	104	208
6 to 9 years	6½	91	26	117	247
Girls					
9 to 12 years	13	104	39	130	286
12 to 15 years	13	117	52	130	299
15 to 20 years	13	104	65	130	286
Boys					
9 to 12 years	13	117	39	117	286
12 to 15 years	13	156	39	117	312
15 to 20 years	19½	208	39	130	338
Women					
20 to 35 years	13	78	78	117	299
35 to 55 years	13	65	78	117	260
55 to 75 years	6½	65	39	117	221
75 years and over	6½	52	39	117	195
Men					
20 to 35 years	13	156	39	117	338
35 to 55 years	13	130	39	117	299
55 to 75 years	6½	117	39	117	286
75 years and over	6½	104	39	117	273

Determine the quantities of vegetables needed for your family, using figures from the table above.

Family Members and Age	Dried Beans, Peas, Nuts (lbs.)	Potatoes (lbs.)	Dark Green and Deep Yellow (lbs.)	Tomatoes and Citrus Fruit (lbs.)	Other Vegetables and Fruits (lbs.)
Example: John, 13	13	156	39	117	312
Father					
Mother					
Total					

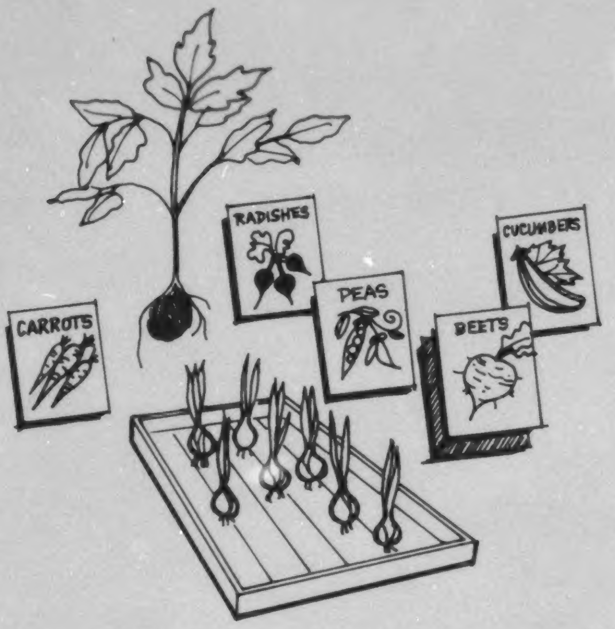


Fig. 2: Select best quality seed, sets, and plants for gardening success.

Table 2: As a Guide, the Following Is an Approximate Yield in Canned or Frozen Vegetables from Fresh

Beans, lima (in pods)	1 bu. (32 lbs.)	12-16 pts.
Beans, Snap, green and wax	1 bu. (30 lbs.)	30-45 pts.
Beets (without tops)	1 bu. (52 lbs.)	35-42 pts.
Broccoli	1 crate (25 lbs.)	24 pts.
Brussels sprouts	4 qt. boxes	6 pts.
Cauliflower	2 med. heads	3 pts.
Corn, sweet in husks	1 bu. (35 lbs.)	14-17 pts.
Kale	1 bu. (18 lbs.)	12-18 pts.
Peas	1 bu. (30 lbs.)	12-15 pts.
Peppers, green	⅔ lb. (3 peppers)	1 pt.
Pumpkin	3 lbs.	2 pts.
Spinach	1 bu. (18 lbs.)	12-18 pts.
Squash, summer	1 bu. (40 lbs.)	32-40 pts.
Squash, winter	3 lbs.	2 pts.
Sweet potatoes	⅔ lb.	1 pt.

they can be included in the garden if they are family favorites.

Plant perennial crops such as asparagus and rhubarb along one side of the garden where they will not interfere with the soil preparation and cultural practices used for growing annual vegetables. These crops may remain in the garden from 5 to 20 years.

Tall growing crops should be planted at one side of the garden where they will not shade lower growing crops. Grouping crops that mature early helps plant later crops that require more growing space. Allow plenty of space between rows for easy cultivation and harvest.

Make special plantings to provide the necessary vegetables for home canning and freezing. To depend upon garden surpluses not used as fresh vegetables may result in insufficient supplies for preservation. Also, by the time the vegetables have become "surplus" their quality has usually deteriorated.

If garden space is available, include:

1. Two leafy, green or yellow vegetables such as leaf lettuce, spinach, Swiss chard, kale, squash, etc.
2. Two pod vegetables such as peas, snap beans, or lima beans.
3. Two root crops such as carrots, beets, turnips, parsnips, radishes, and salsify.
4. Tomatoes and cabbage.
5. Additional vegetables as family tastes may indicate.

Succession Planting

Gardeners can get the greatest use and production from available growing space by making companion and succession plantings. **Companion cropping** consists of raising two vegetables in the same area at the same time. One crop matures and is removed from the garden by the time the other companion is ready for harvest. An example of companion cropping is planting lettuce and cabbage alternately in the same row. The lettuce matures first and is harvested before it interferes with the growth of the cabbage. Radishes can be seeded between rows of cabbage, broccoli, and cauliflower. Early beans, lettuce, radishes, or spinach can be planted between tomato, eggplant, pepper, and late cabbage rows.

Succession plantings help insure a continuous supply of fresh vegetables from early spring to late autumn. Succession plantings may be done in a variety of ways. One way is to make three or four plantings of a vegetable such as radishes or leaf lettuce every 7 to 10 days. Radishes, for example, may be planted on April 15, April 25, and again May 4. The crop matures rather quickly and should be harvested in each case before the arrival of the long hot days of summer. Radishes grow best when the temperatures are cool during days of early spring.

A second type of succession planting is making a single planting of several vegetable cultivars having different maturity dates. An example of this type planting is seeding Spring Gold, an early maturing sweet corn cultivar; Gold Cup, a midseason cultivar; and Golden Queen, a late cultivar, on the same day. This planting procedure provides sweet corn over a period of several weeks.

A third type of succession planting is the harvesting of one crop that has matured and replacing it with a completely different crop. An example is the following of early sweet corn with a crop such as turnips or Chinese cabbage.

Equipment and Supplies

The success and enjoyment gained from vegetable gardening depends, in part, upon the proper equipment and supplies for doing specific jobs when they should be done. Many tools and supplies are available to aid the gardener in accomplishing the various gardening tasks. Some of these are essential while others are helpful if possessed but are not absolutely necessary. As there are often alternative ways of doing certain gardening tasks, the type of equipment and supplies needed depends upon the procedures used and the size of the garden. For example, in preparing a seedbed, one could spade and rake the soil, use a tiller, or hire a neighbor who has a garden tractor to plow and prepare the garden area.

The smallest garden requires a spading fork, hoe, rake, trowel, and pointed stakes and strings for laying out the plant rows. A good hand duster or sprayer for the application of insecticides and fungicides is essential.

Power equipment such as this tiller is available in sizes the home gardener can use. Gardeners may also want to investigate larger models with tilling tines at the rear of the machine.

You may want to select gardening equipment and supplies from the following lists:

Equipment
Garden tractor, plow, and disc
Tiller
Spading fork or shovel
Wheel barrow
Fertilizer spreader
Hoe
High wheel cultivator
Trowel
Garden seeder
Compression sprayer
Hand duster
Trombone sprayer
Power sprayer or duster
Sprinkler can
Garden hose and sprinkler
Respirator

Supplies
Pointed stakes
String
Yardstick
Seed protectant
Seed innoculant
Starter fertilizer
Dry fertilizer
Rubber gloves
Insecticides
Fungicides
Plastic film
Plastic tags or plant labels
Peat Moss
Vermiculite
Lime
Sawdust
Coarse sand

Regardless of equipment and supplies selected, the gardener must make provisions for accomplishing the following basic gardening operations:

1. Soil preparation including conditioning to modify undesirable soil structure.
2. Maintaining or increasing soil fertility.
3. Proper planting and thinning of crops where necessary.
4. Controlling weeds.
5. Preventing insect and disease damage to plants in safety to the gardener and other individuals.
6. Maintaining adequate soil moisture.

Production Procedure

Recommended Cultivars and Hybrids

Excellent cultivars and hybrids are now available. Seed companies and state agricultural research and development centers employ plant breeders and research personnel who work to develop new cultivars and hybrids and improve the older ones.

When choosing vegetable cultivars or hybrids for the home garden, such factors as disease resistance, yield or harvest to be expected, quality of the product, maturity date, and size, shape and color of the vegetable should be considered.

When selecting vegetable cultivars and hybrids, keep in mind the following:

1. Recommendations published each year by the Ohio Cooperative Extension Service. Use these recommendations as a guide for your selections.
2. Past experience with vegetable cultivars and hybrids in determining which types to plant. Compare promising new cultivars and hybrids with favorate "tried and true" cultivars.
3. Intended use for the vegetables. Select cultivars and hybrids for specific purposes such as exhibition, processing, or fresh use.

If you have been planting a particular cultivar that is not listed and have found it satisfactory under your climate and soil conditions, then continue planting it. However, if you are dissatisfied with performance of some of the cultivars and hybrids used in your garden, you may want to try others.

Currently recommended cultivars and hybrids for Ohio growing conditions are given in Ohio Cooperative Extension Leaflet L-100 "Recommended Vegetable Cultivars and Hybrids for Ohio Home Gardeners." Obtain it from your local Cooperative Extension Service office.

Planting Time

Garden vegtables may be grouped into two general classes—the cool season crops which are most successfully grown when planted in the early spring (a few can be planted in the fall), and the warm season vegetables which produce best when grown during midsummer.

Cool season crops may be planted as soon as the soil can be worked in the spring. These crops include peas,

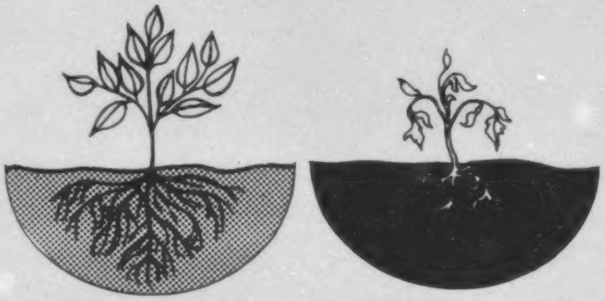


Fig. 3: Poor plants usually result unless clay soil (right) is improved with organic matter (left) to increase aeration and drainage.

beets, cabbage, broccoli, carrots, spinach, lettuce, radishes, onions, and mustard. Many of these early season crops mature after a short growing season and can be followed by warm season crops planted as soon as the early crop is harvested.

Warm season crops must not be planted until after the danger of frost is past. These crops include beans, sweet corn, lima beans, squash, cucumber, muskmelon, tomato, pepper, eggplant, and sweet potatoes. Crops such as beans and sweet corn may follow the cool season crops in the same row.

Refer to the planting Tables 3 and 4 for recommended planting dates. A late or wet spring may delay plantings. When this happens, the plantings should be made as soon as conditions permit. An early spring may permit plantings earlier than normal. Unfavorable growing conditions often make extremely early plantings less productive than those made during the recommended planting times.

Table 3: Vegetables Seeded Directly in Garden

Vegetables	When to Sow or Plant	Depth In Inches	Seed per 100 feet	Days to Maturity	Planting Distance In Inches		Estimated Yield per 100 feet of Row
					In the Rows	Between Rows*	
Asparagus, crowns	March-April	6-8**	60 crowns	No harvest first year	18	48–60	30 lbs.
Beans, bush snap	May 15 to August 1	½–1	1 lb.	50– 60	3	24	50 lbs.
Beans, green shell	May 15 to July 1	½–1	1½ lbs.	60–100	3	24	
Beans, dry shell	May 15 to June 1	½–1	1 lb.	90–100	3	24	50 lbs.
Beans, bush lima	May 20 to June 10	½–1	1 lb.	65– 85	6	24–30	50 lbs.
Beans, pole snap	May 15 to June 1	½–1	½ lb.	65– 90	24	36	
Beans, pole limas	May 20 to June 1	½–1	¾ lb.	70–100	24	36	
Beets	April 15 to August 1	½	½ oz.	50– 70	3	18	100 lbs.
Cabbage, Chinese	August 1	¼	1 pkt.	80– 90	15	24	80 heads
Carrots	April 1 to July 15	¼	½ oz.	55– 75	3	18	100 lbs.
Chard, Swiss	April 1 to April 10	½	½ oz.	50– 60	8	24	50 lbs.
Collards	April 1 to August 15	¼	1 pkt.	65	15	24	50 lbs.
Corn, Sweet	May 1 to July 1	1–2	4 oz.	64– 90	12	24	100 ears
Cucumber	May 10 to June 1	1–2	½ oz.	50– 70	12	60	12-15 fruit/ plant
Endive	August 1	½	1 pkt.	90–100	15	24	50 lbs.
Kale	April 1 to August 1	½	1 pkt.	50– 70	18	24	75 lbs.
Kohlrabi	April 1 to August 1	½	¼ oz.	50– 70	4	18	100 lbs.
Lettuce, leaf	April 1 to August 1	¼	1 pkt.	40– 50	6	18	50 lbs.
Lettuce, head	August 1	¼	1 pkt.	60	12	24	50 lbs.
Mustard	April 1 to August 15	¼	1 pkt.	40	8	24	50 lbs.
Muskmelon	May 15	1–2	½ oz.	70-100	30	60	50 fruits
Okra	May 1	½	½ oz.	65	15	30	
Onions, seed	April 1	½	1 oz.	110–150	3	18	50-100 lbs.
Onions, sets	April 1	1–2	2 lbs.	100–140	3	18	
Onions, winter	Sept. 1 to October 1	1–2	3 lbs.	—	2	18	
Parsley	April 1 to April 10	⅛–¼	1 pkt.	55– 60	6	18	50 lbs.
Parsnips	April 1	½	½ oz.	130–140	3	24	100 lbs.
Peas	April 1	½	1 lb.	50– 60	1	18	40 lbs. (pods)
Potatoes, early	April 1	3–4	10 lbs.	90–110	9	24	100 lbs.
Potatoes, late	May 15	3–4	9 lbs.	110–140	12	24	
Pumpkin	May 20	1–2	½ oz.	90–110	48	84	75 fruits
Radish	April 1 to August 1	½	1 oz.	25– 35	1	18	25 lbs.
Rhubarb	April	2–3	50 crowns	365	24	36	
Rutabaga	July 1 to July 15	½	¼ oz.	100–120	6	24	150 lbs.
Salsify	April 1 to April 10	½	½ oz.	140–150	2–3	18	75 lbs.
Spinach	April 1 and Sept. 1	½	½ oz.	40– 50	6	18	50 lbs.
Spinach, N. Zealand	April 10 to May 1	½	½ oz.	60– 80	15–18	30	
Squash—							
Bush	May 1 to June 1	1–2	½ oz.	50– 65	36	48	
Summer Vine	May 1 to June 1	1–2	½ oz.	50– 65	60	84	
Winter	June 1 to June 15	1–2	½ oz.	60–110	60	84	100 fruits
Turnips	April 1 to June 1 and Aug. 15	½	¼ oz.	50– 60	3	18	100 lbs.
Watermelon	May 20	1–2	½ oz.	110–130	96	96	

* Adjust row spacing as necessary to accommodate equipment used for cultivation.

** Two inches of soil cover at planting. Gradually fill trench 6-8" deep with soil.

Table 4: Vegetables Started from Plants

Vegetables	Start	Move Plants to Coldframe	Set Plants in Garden	Days to Maturity from Setting Plants	Planting Distance In Inches: In the Rows	Planting Distance In Inches: Between Rows*	Estimated Yield per 100 feet of Row
Broccoli	Feb. 20	March 15	April 1	80	18	24	50 lbs.
Brussels sprouts	June 1-10	None	July 1	120	24	24	50 lbs.
Cabbage, early	Feb. 20	March 15	April 1	50	15	24	180-240 lbs.
Cabbage, late	May 15-June 1	None	July 15	75–80	18	30	
Cauliflower	June 1-10	None	July 1	100	24	30	45 heads
Celery, early	Feb. 1	None	April 20	90	6	24	200 stalks
Celery, late	April 15	May 15	July 1	110	6	24	
Egg plant	March 20	April 15-20	May 15**	80–90	24	36	150 fruit
Lettuce, head	Feb. 20	March 1	April 1	60	12	24	50 lbs.
Tomatoes	March 20	April 10	May 15	50	24	36	250 lbs.
Peppers	March 20	April 10	May 15	70	18	24	300 peppers
Sweet Potato	April 10	None	May 20	120	12	30–36	

Note: The planting dates are for normal seasons in central Ohio. Spring planting dates will be about 2 weeks earlier for southern Ohio, and 2 weeks later for northern Ohio.

* Adjust row spacing as necessary to accommodate equipment used for cultivation.

** Or after danger of frost is passed.

Cultural Practices

A cultural practice is a specialized activity used to take care of crops. By using the proper cultural practices at the right time, the grower creates conditions for the growth of healthy plants capable of producing a good harvest. Some cultural practices for growing crops include:

Cultivating
Mulching
Irrigating
Spraying or dusting
Weeding
Staking and tying
Caging
Fertilizing and liming
Pruning
Flower removal
Blanching
Thinning

Cultivation—Loosening of the soil with an implement. The implement may be hand powered, such as a hoe or high wheel cultivator, or it may be power operated, such as a tiller or garden tractor weeder. The purpose of cultivation is chiefly that of destroying weeds although air is admitted to the soil during the process. Plant roots require air for best growth. A loosened soil is capable of absorbing more moisture during periods of rainfall than compacted soil. Much care must be used in cultivation as many vegetable plants have a shallow, wide spreading root system which can be damaged by deep cultivation.

Mulching—Application of materials such as straw, damaged hay, grass clippings, peat moss, and plastic film to the soil surface. The purpose of mulching is to:

1. Conserve soil moisture
2. Help control weeds
3. Maintain a uniform soil temperature
4. Help reduce fruit rot
5. Help reduce blossom drop, blossom end rot, and leaf roll of tomatoes by maintaining a more uniform soil moisture supply

Irrigation—Watering crops during periods when rainfall is not enough to maintain sufficient moisture in the soil for good crop growth. Care must be used so that plants are not overwatered. Overwatering leads to root disease and often death of the root system. Vegetable plants must have healthy root systems to be productive.

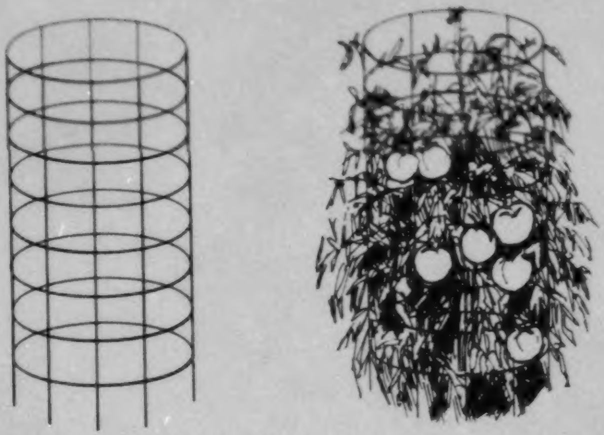
Frequent, shallow waterings tend to encourage development of a shallow root system which can be harmful to the plants during hot, dry periods, especially if mulches are not used.

Learning how to provide plants the proper amount of water is an art which is developed with experience.

Weeding—Removal of unwanted plants from area where desirable plants are being grown. Weeding may be done by hand, power cultivation, use of plastic sheeting, or chemicals known as herbicides. Weeds compete with vegetable plants for sunlight, water and nutrients in the soil, and growing space. They also harbor insects which may spread disease to the vegetable plants. Weeds must be kept out of the garden if high yields of quality products are to be obtained.

Staking and tying—Training plants to some desired growth habit. Staking and tying is a cultural practice often used in growing tomatoes. Some advantages of staking and

Staking, tying, and pruning tomatoes can result in earlier season tomatoes, cleaner fruit, and less rot.



Caging reduces labor for supporting plants and often increases yields.

tying tomatoes are: tomatoes earlier in the season, cleaner fruit, and less fruit rot. Other vegetables which may be staked and tied include pole snap and pole lima beans.

Caging—Caging can be used in place of staking to support tomato plants. The cages may vary in size from 30 inches tall and 15 inches in diameter to 50 inches tall and 18 inches in diameter. For smaller growing, determinate type plants, the smaller cages work satisfactorily.

Advantages of caging include reduced labor for supporting the plants and often times increased yields, and higher quality fruit depending upon the cultivar grown.

Caged tomatoes usually are delayed in maturing fruit as compared to staked tomatoes.

Fertilizing and liming—Application of agricultural chemicals to the soil for the purpose of increasing soil fertility. Determine the amount of lime and fertilizer to use on a garden soil by the results of a soil test. It is impossible to look at a soil and tell whether or not it needs lime or fertilizer. Adding fertilizer or lime when it is not needed can result in plant growing problems.

Pruning—Removing plant parts to get the desired type of plant growth. Plants may be pruned to make cultivation easier, develop more compact and bushy plants, reduce the amount of vegetative growth, and admit more light to the center of the plants. Pruning or suckering is a common cultural practice for growing staked tomatoes.

Flower removal—Reducing the number of flowers which will develop into fruit. This is done to increase the size of the fruit left to develop. This cultural practice is used for the production of exhibition vegetables, such as pumpkin and squash. Since this practice is very time consuming, it is not used in the commercial production of vegetables.

Blanching—Preventing sunlight from striking certain plant parts. Lack of sunlight causes plant parts to fail to develop the green coloring (chlorophyll) such that the parts are white in color. Blanching may be done by mounding soil around the plant part as in growing celery and asparagus or by tying the leaves over the plant part as with cauliflower and sometimes endive.

Thinning—Removal of excess plants growing in a thickly seeded row. Removal of some plants allows growing space for the remaining plants. This practice is most necessary with the direct seeded root crops such as radishes, beets, carrots, parsnips, salsify, and turnips.

Desirable Practices

1. Use mulches to conserve moisture, control weeds, and reduce the amount of fruit rot.
2. Keep plants free of insect and disease damage.
3. Examine garden plants regularly to detect problems early.
4. Keep garden weed free.
5. Remove tomato suckers when small (one or two inches long), if plants are staked and tied.
6. Sample the soil and have it tested at least once every 3 years.
7. Apply fertilizer and lime to vegetable crop soils using soil test results as guide.
8. Thin thickly seeded row crops so that remaining plants will have more growing space.
9. Drive tomato stakes into the soil soon after plants have been set rather than waiting until plants have become well established.
10. Avoid walking and working in the garden when the soil and plant foliage is extremely wet.
11. Use mulch materials free of weed seeds.
12. Keep materials well agitated in the sprayer tank.

Undesirable Practices

1. Cultivating so deeply that many plant roots are removed or severely damaged.
2. Keeping the soil in a wet, soggy condition by excessive watering.
3. Applying pesticides to vegetable plants without reading directions on the chemical container or observing safety precautions.
4. Using cultivars not suited to the locality.
5. Allowing weeds to take over the garden.
6. Mounding the soil up around plants so that rainfall drains away from the root system rather than soaking in next to the plant.
7. Planting the rows too close together so that it is difficult to get a cultivator between the rows without damaging the plants.
8. Tying the tomato stem so tightly to the stake that the developing fruits are damaged by rubbing the stake.
9. Placing a handful of fertilizer in the hole where the tomato plant is to be set.
10. Failing to have the soil tested at least every 3-4 years.
11. Using lawn fertilizers containing herbicides in the garden.

An important factor in maintaining productivity of mineral soils is the incorporation of large amounts of organic matter. Make regular and heavy applications of compost, peat moss, weathered sawdust, or manure (if available). Mulching materials such as straw and damaged hay also add to the soil organic matter supply. Organic matter helps increase the water holding capacity of sandy soils, makes heavy clay soils easier to work, helps prevent soil crusting and compaction, and serves as a source of plant nutrients.

All gardens should be protected by a winter crop such as rye or ryegrass (or winter barley in southern Ohio). Rye is preferable for late (after September 15) cover crop seedings.

Cereal rye and barley are seeded at a rate of ⅓ pound per 100 square feet of area. Ryegrass is a suitable soil cover crop but should be seeded prior to September 15 for best results. It is seeded at a rate of 3 ounces per 100 square feet or 1½ to 2 pounds per 1,000 square feet.

Cover crops prevent soil erosion and add large quantities of organic matter when turned under in the spring. However, such crops should be turned over before growth is so tall that they are difficult to handle. Cover crops may be seeded between the rows in September if the vegetables are not yet harvested.

Liming

If vegetable plants are to make satisfactory growth, the soil must supply plants with necessary nutrients in sufficient amounts and in a form available for absorption by plant roots. Sometimes soils contain the proper amounts of plant nutrients, but the nutrients are in a chemical form that is unavailable to the plant root system. This condition may result because the soil reaction (pH) is at an unsatisfactory level. Soil reaction refers to whether a soil is acid, alkaline (basic), or neutral. Soil reaction is indicated by means of a pH scale. Soils of pH 7.0 are neutral. Soils of pH below 7.0 are acid while those with a pH above 7.0 are alkaline. Most vegetables grow best when the pH level of soil is between 5.8 and 6.8, Fig. 4. Potatoes are generally grown in soils with a pH of 5.5 or below so as to reduce the problem of scab disease.

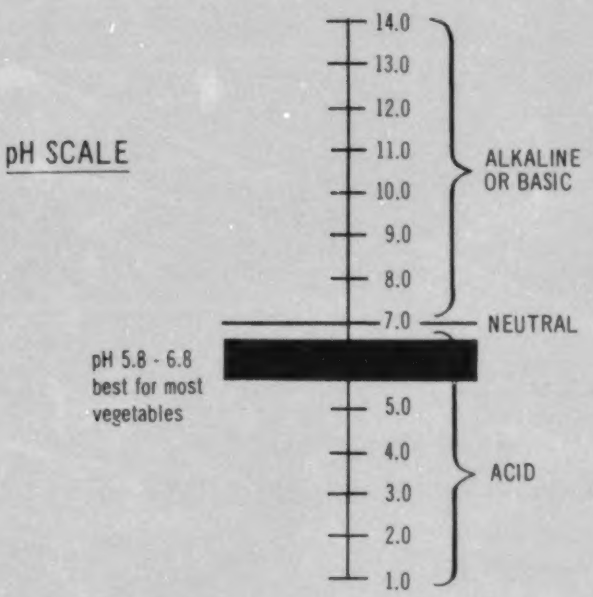


Fig. 4: A soil pH level of 5.8 to 6.8 is best for most vegetables.

The soil reaction is best determined in a soil testing laboratory with an electric pH meter.

Agricultural lime is useful for correcting an extremely acid soil condition. However, the addition of lime to the soil when it is not needed can create plant growing problems. A light application of lime at regular intervals will usually maintain the soil at the desired pH level. In general, about 5 pounds of ground limestone per 100 square feet of garden space every 5 years will maintain the proper level. Hydrated lime may be used provided the rate is cut in half. Use of wood ashes is only one-third as valuable as ground limestone for correcting soil acidity. Coal ashes have little value.

On light, colored soils that have never been limed, apply 15 to 20 pounds of ground limestone per 100 square feet (or an equivalent amount of other materials) as an initial application. Then follow the regular applications suggested above.

Extremely alkaline soil conditions are reduced by the application of sulfur. If you want accurate information regarding soil reaction and fertility level, arrange for a soil test through the office of your local county Extension agent.

Fertilizing

Fertilization is an important practice in growing all vegetable crops. When properly used, fertilizers help achieve better plant growth and increased yields. When improperly used, they are of little value and may result in more damage than benefit to the crops.

Fertilizer cannot:

1. Correct or improve a soil structure which does not allow sufficient aeration or drainage for satisfactory plant growth.
2. Adjust an unsuitable soil reaction. There may be adequate nutrients in the soil, but they may be unavailable to plants due to a high soil acidity or alkalinity.
3. Compensate for poor seeds or plants.

Fertilizer used by gardeners may be either organic or inorganic in type. Organic fertilizers are products of living things and include manure, fish meal, and blood meal. Organic fertilizers are generally known as non-burning fertilizers. Although poultry and rabbit manure are organic in nature, they must be used with caution in the garden because of the concentrations of nitrogen which they contain. Use no more than 10 pounds of these types of manure per 100 square feet of garden area.

Inorganic fertilizers are those produced from chemically treated rocks and minerals. Gardeners may use either organic or inorganic fertilizers with good results if used at recommended rates.

Fertilizers may be applied to the garden soil as either liquids or solids. Liquid fertilizers are used for starter

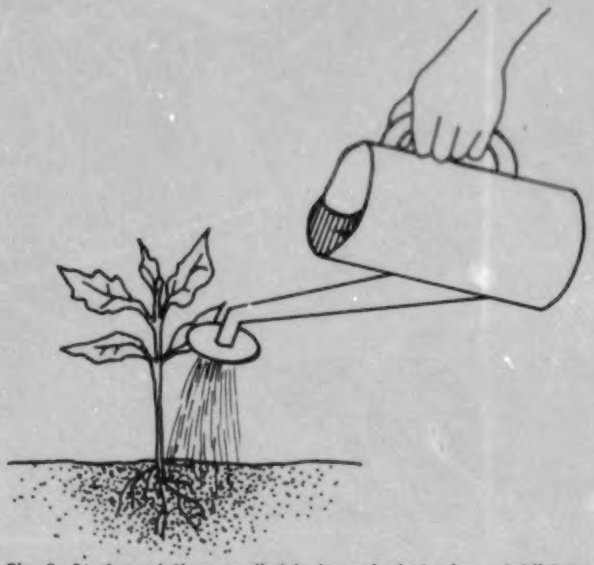


Fig. 5: Starter solutions applied to transplants hasten establishment and encourage rapid growth.

solutions or foliar feeding. Starter solutions are applied to transplants at the time they are set to hasten establishment and to encourage more rapid growth, Fig 5. Foliar fertilizers are sprinkled or sprayed on the plant foliage where the plant nutrients are absorbed through the leaves and used by the plants. Generally, this method is not satisfactory for getting all the required nitrogen, phosphorus, and potassium into the plant. These nutrients are best supplied from the soil. Fertilizers may be either complete or incomplete. Complete fertilizers contain the 3 primary plant nutrients—nitrogen, phosphorus, and potassium. An example of a complete fertilizer is 8-16-16. Incomplete fertilizers lack one or more primary plant nutrients. Examples are 0-20-0 or 0-20-20. "Trel" fertilizers contain trace elements in addition to the primary elements.

There are many different fertilizer analyses and brands available today. Fertilizers commonly used in vegetable crop production include 8-16-16, 5-10-10, 4-16-8, 3-9-18, 6-24-24, and 12-12-12. The 3 number sequence used to describe fertilizers is known as the fertilizer analysis. The first figure in the analysis refers to the percentage of nitrogen in the fertilizer. The second number refers to phosphorus as the percent of water soluble phosphoric acid equivalent, while the last number refers to potassium as potash, Fig. 6. A fertilizer like 10-6-4 is high in nitrogen; 4-16-8, high in phosphorus; and 6-12-18, high in potassium.

Nitrogen is important in the development of the dark green color in plants, promotes rapid vegetative growth, and improves the quality of leafy crops. This plant nutrient must not be over used with vegetables such as tomatoes or excessive vegetative growth will result at the expense of fruit production. Phosphorus promotes early root formation and growth. It gives plants a rapid and vigorous start, stimulates blooming, aids in seed formation, and hastens maturity. Potassium is essential to plant health and disease resistance and increases the fullness of seeds. In addition to nitrogen, phosphorus, and potassium, 13 other elements, including the trace elements, are known to be of vital importance to satisfactory plant growth. Usually, most home garden soils contain satisfactory amounts of the trace elements for good vegetable plant growth.

Row or band applications make the most efficient use of a small amount of fertilizer. Row or band applications must be made so that seed or roots do not come in contact with the fertilizer. The best method is to make small furrows about 3 inches to each side of the row, and 2 to 3 inches deep. Apply the fertilizer in the furrows using 1 to 2 pounds per 100 feet of row. Then level the soil off and make a row midway between the strips of fertilizer. Next, sow the seed in this row. It is important not to use more than 1 to 2 pounds of fertilizer per 100 feet of row in the row application or plant injury may result. This method of application is very efficient, but much hand labor is involved. For this reason, it is not widely followed.

It is desirable to apply some fertilizer in addition to the row application described above. The best method is to broadcast about 2 pounds per 100 square feet of garden space. This amount can be plowed down or spaded under, or it can be applied to the garden after it is plowed or spaded, and then worked into the soil to a depth of 2 or 3 inches prior to planting. The latter method is considered best on coarse, sandy soils.

Where it is impractical to make the row application, the broadcast application may be increased. An effective practice is to apply half of the fertilizer broadcast before plowing or spading and the remainder afterward.

When fertilizer is not applied by either of the above methods, supply transplanted crops such as tomatoes and cabbage with about 2 tablespoons of fertilizer applied below the plant. Prepare the hole 2 or 3 inches deeper than the plant requires, add the fertilizer, and cover with 2 to 3 inches of soil, then set the plant in the usual manner. This hill method of application can also be used with cucumber, melon, and squash plants.

Starter Solutions

Starter fertilizers are very useful in getting transplants off to a good start. A satisfactory solution may be made by stirring 2 tablespoons of a complete fertilizer, such as 3-12-12, 5-10-10, or 8-16-16 in 1 gallon of water. Mix well, and apply about 1 cup of this solution on the soil around the roots of each plant at transplanting time. The insoluble residue may be applied to the garden as it has some fertilizing value. Do not make the nutrient solution stronger than directed or burning is likely to result. The home

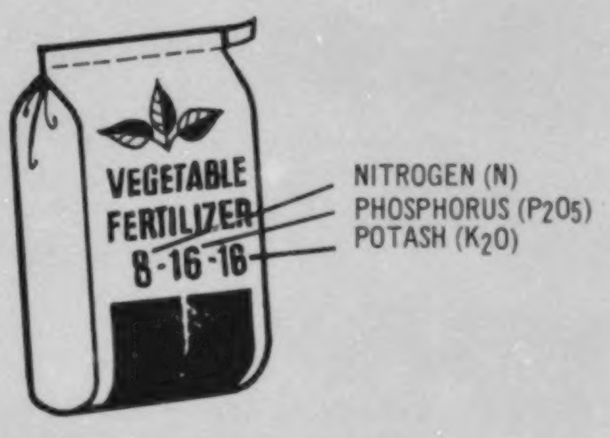
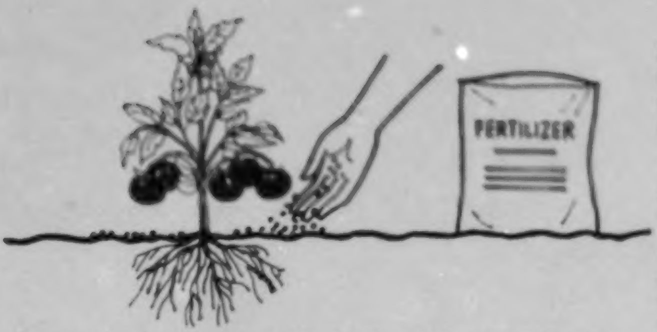


Fig. 6: Fertilizer analysis numbers refer to the percentage by weight of N, P_2O_5, and K_2O (nitrogen, phosphorus, and potassium).



Nitrogen fertilizers used as side dressings are useful with some vegetables. Avoid contact with plants.

gardener can also purchase ready-to-use, soluble fertilizers of such analyses as 23-19-17, 10-52,17, 15-52-9, 10-50-10, 20-20-20, 13-26-13 and others. These materials may be used as starter fertilizers in the water poured around plants at transplanting time. They can also be applied through the watering system by using a proportioner. In all cases, follow manufacturer's directions.

Serious plant injury can result if too much starter fertilizer is improperly applied. High phosphorus materials like 10-52-17 and 10-50-10 are especially suitable as a starter fertilizer at transplanting for tomatoes, peppers, and eggplants.

Side Dressing

A nitrogen-carrying fertilizer is often useful as a side dressing with some vegetables. The application may be made to leafy vegetables after the plants are well started, to corn when it is 12 to 15 inches tall, and to tomatoes after the first fruits have "set." An 8-16-16 formula is more likely available for home gardeners. Apply 2 pounds of the fertilizer per 100 feet of row, but avoid contact with the plants as burning will result. If you use a straight nitrogen fertilizer such as nitrate of soda—16 percent nitrogen, or ammonium nitrate—33.5 percent nitrogen, apply a smaller amount. Use ½ pound of the 16 percent, or ¼ pound of the 33.5 percent product per 100 feet of row. **CAUTION: Do not use fertilizers containing herbicides in the home garden!**

Seeding & Planting

Seedbed Preparation

The methods of seedbed preparation used largely determine the condition of the soil throughout the growing season. Ideal conditions for the best growth of plants require an open soil in which aeration and water drainage are good. The ideal seedbed is one which has been worked as little as possible to provide a satisfactory place to sow the seeds. It is not necessary to break up all the small clods on the surface of the soil.

Some heavy soils are benefited by fall plowing or preparation. Such soils will be loose and fluffy in the spring as a result of the conditioning effect of frost action. Fall plowed soils require only leveling in the spring before planting. A light raking or harrowing is all the seedbed preparation required. Fall plowing is advisable only on level soils which do not work well after spring plowing, and when liberal applications of organic materials are made.

Spring plow or spade when the moisture content of the soil is such that the soil "shatters" when turned. If worked too wet, heavy soils become hard and will not handle well for the entire season. If a handful of the soil can be pressed into a ball, plowing or spading should be delayed.

When moisture conditions are right, soil crumbles freely. Such soil requires a minimum of preparation. Usually raking or harrowing to level the soil is all that is required. Soil that requires several fitting operations should be worked on the dry side rather than wet. Very loose, sandy soils may require firming or settling during preparation.

Obtaining Plants

Usually the home gardener finds it most practical and satisfactory to purchase plants from a local plant grower. However, if you want to grow new or unusual cultivars, or if plants are not available, growing your own seedlings is necessary.

Plants may be grown in a hotbed, in a sunny window, or preferably under balanced lighting. Start the plants in a seed flat, if a hotbed is used, or in a box 4 to 5 inches deep for use in the window.

To germinate seed, use a medium that is free of disease organisms and weed seed. Sphagnum moss, vermiculite, mixtures of peat and perlite or peat and vermiculite are satisfactory for seed germination. If soil is to be used for germinating seed, it must be sterilized to eliminate soil-born disease and damping off. Damping off is a serious disease of seedings and can be identified by examining the seedling stem at the soil surface. Seedling stems infected with damping off are constricted and dark in color at the base. Such stems are very weak and the seedlings soon fall over and often die. Commercial materials are available for preparing soil drenches and may be used to treat the soil prior to seeding.

Sow the seed in rows 2 inches apart. Seed may be distributed in the row as close as 4 per inch, since the young plants should be transplanted as soon as the first true leaves are formed. Cover the seed lightly with soil or sand and water with a fine spray. A plastic film or glass plate cover over the seeded container helps reduce drying until plants are up. **Remove the cover just before the first seedlings emerge.**

When first true leaves develop, transplant to other flats or pots. Set plants at least 2 inches apart for good development.

Water, applied carefully, is essential to good plant growth. Water thoroughly and as often as necessary to prevent drying out. Hold diseases in check by keeping foliage dry. Apply water on sunny mornings and provide adequate ventilation. Frequent light waterings tend to keep the foliage wet and encourage diseases. Too much water encourages soft, succulent growth and damping off while too little water produces very hard plants. Avoid both extremes for the most productive plants.

Seed

Use only the best quality seed in the home garden. Top quality seed have a high germination percentage, produce plants true to varietal type and that are clean and free of disease causing organisms.

In general, avoid using seed taken from previous vegetable crops in a new garden planting. Such seed may produce a large number of off-type plants because they come from plants where cross pollination may have occurred. Too, such seed may carry disease causing organisms which can spread infection to the garden plants.

Seed left over from the previous year may be satisfactory for making a new garden planting if they were properly stored in a cool, dry location and are seeded at a slightly greater rate than new seed. Viability decreases as seed becomes older.

Vegetable seed may be divided into the following general groups:

1. Comparatively short-lived, usually not good after 1 to 2 years: sweet corn, leek, onion, parsley, parsnip, salsify.
2. Moderately long-lived, often good for 3 to 5 years under favorable conditions: asparagus, bean, Brussels sprouts, cabbage, carrot, cauliflower, celery, chicory, cress, endive, kale, kohlrabi, lettuce, okra, peas, pepper, radish, spinach, turnip, and watermelon.
3. Comparatively long-lived under favorable conditions; may be good for more than 5 years: beets, cucumber, muskmelon, mustard, and tomato.

You can easily test seed viability by making a trial planting in a flower pot or tray in soil or sand. Keep in temperature range of 70 degrees F. and check germination in a week or so.

Establishing the Plants

Make straight rows by stretching a string between stakes set up at the ends of the row. Stretch the string tight enough to lift it just above the surface of the soil.

Small vegetable seeds such as lettuce and radish, should not be planted more than ¼ inch deep. For such small seed, the hoe or rake handle is an excellent tool for opening the shallow seed furrow.

For larger seed such as peas and beans, the proper depth is ½ to 1 inch, Fig 7. Late plantings may be somewhat deeper than early plantings.

Sow the seed thinly by shaking them from a cut corner of the package or individually dropping the seeds from the fingers (larger seeds only). Many gardeners waste seed and make extra work by sowing them too thick. After seeding, draw soil over the seed, using the corner of a hoe. In case the soil is cloddy, draw in the finer soil to cover the seed.

Firm sandy soils above the seed to hasten germination. On heavy soils where crusting is likely, packing of the soil above the seed increases the danger of crusting. On such soils, a shower or irrigation may be necessary to facilitate germination, and wetting reduces the severeness of crusts if the soil is packed.

Late planted seed during the summer may not germinate unless provisions are made to retain the moisture. When sowing late-seeded crops, water along the rows and cover with a board or a light mulch. Watering seed during summer without protection against evaporation usually results in failure, as the soil drys rapidly and young seedlings die before emerging. Uncover the rows when the first plants appear.

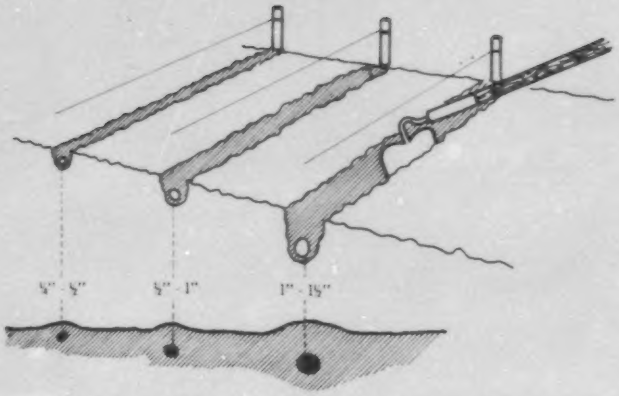


Fig. 7: Seed furrows may be prepared with a hoe. Make the furrow shallow for small seed.

Most gardeners sow too many seed. Consequently, plants are too close if seed have good germination.

Thin root crops when they are still small. Turnips, for example, need 3 inches between plants and should be thinned before tap roots become fleshy. Carrots should be thinned early and allowed to stand 1 inch apart. Swiss chard can be thinned to 3 inches. Then as plants develop, harvest alternate ones. Thin cucumbers and melons to 2 to 3 plants per hill or to stand 12 to 15 inches apart in the row. Beets should be thinned to 2 to 3 inches apart.

Transplanting

Plants Growing in Market Paks or Flats: Water the plants several hours before transplanting so that the soil sticks to the roots when the plants are removed from the container. Unmoistened soil crumbles and plant roots may be severely damaged by drying. The time required for plants to recover from the shock of transplanting usually is less for plants planted with a ball of soil on the roots than for those planted with no soil on the roots, Fig. 8.

Dig the holes for the plants slightly deeper than they were previously growing. Place plants in the holes and firm the soil around the roots. A starter solution instead of plain water (see fertilizers) will help give the plants a good start. Draw dry soil over the soaked area. The dry

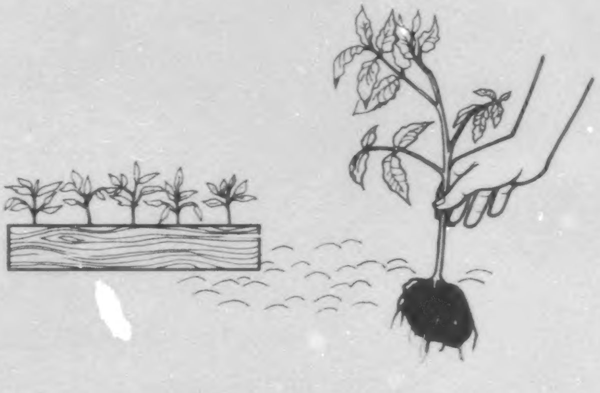


Fig. 8: Transplants with a ball of soil on the roots recover and begin to grow more quickly after transplanting than those whose roots have been dried or severely damaged.

soil on the surface will help prevent loss of moisture and reduce caking of heavy soil around the roots.

Plants set in the evening become partly established before they are subjected to the hot sun and high temperatures of the next day. Shade provided by a newspaper tent, shingle, or wide board will help reduce transpiration during very hot weather. When the soil is dry, or if plants wilt excessively, apply plain water for a few days after transplanting.

Plants in Peat Type Containers: Plants growing individually in peat type containers offer the advantage of practically no transplanting shock. If the plants are growing properly, roots should be starting to grow through the pot walls, Fig. 9. This is an excellent time to set the plants, as any delay could result in drying and loss of roots outside the pot. Where roots are not beginning to show through the pot walls, the plant is either too small to transplant or the pot walls have dried to where plant roots cannot penetrate them. If this has happened, roots then grow around the pot walls inside the pot and the plant becomes rootbound. Plants set out in this condition often remain stunted and dwarfed and do not develop into quality plants during the entire growing season. It is most important to moisten pot walls almost to the point of crumbling before setting the plants. It is also necessary to see that pot walls do not extend above the soil surface when planted. Walls extending above the soil surface serve as a wick to draw moisture out of the soil.

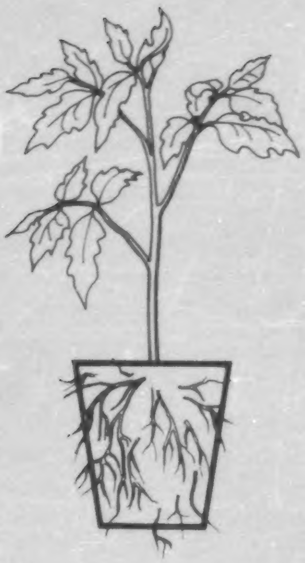


Fig. 9: Plants grown in peat type containers result in practically no transplant shock. Take care, however, to prevent root drying before planting.

Weed Control

Organic Mulches

Weeds may be controlled in the garden and soil moisture retained during the growing season by the application of a mulch.

Apply mulches after the warm-season crops are well established. Usually, this is sometime during the month of June. Apply partially decomposed mulching materials 2 to 4 inches deep. Such materials include weathered sawdust, peat, compost, and rotted manure. These materials will not compete with the plant for available nitrogen.

Mulching materials commonly available and most often used include straw, and damaged hay. Such mulches require nitrogen for decay and when spread on the garden will compete with the plants for available nitrogen in the soil. To assure adequate amounts of nitrogen for decomposition of these materials, apply 2 to 3 pounds per 100 square feet of 5-10-10 or 8-16-16 fertilizer or ½ pound per square foot of nitrate of soda, ammonium sulphate, or ¼ pound of ammonium nitrate.

In the case of sawdust or shavings, add 1 pound of nitrate of soda. ½ pound of ammonium nitrate or ¾ pound of ammonium sulfate to each bushel of material to prevent shortage of nitrogen.

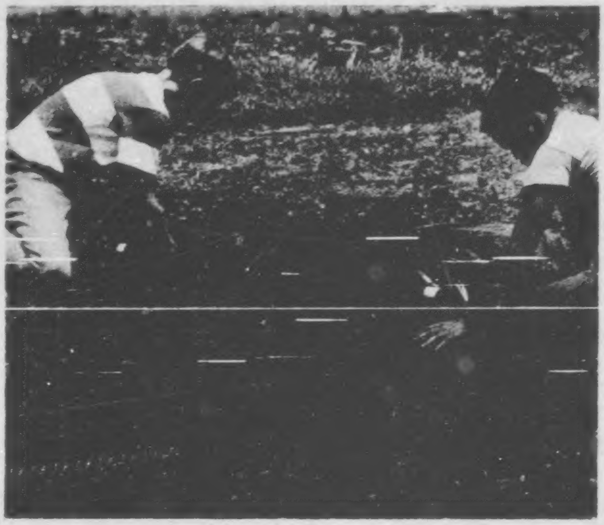
Sawdust and other wood wastes do not contain appreciable amounts of toxic materials, provided the wood has not been treated with a preservative. Cedar shavings or sawdust may retard plant growth slightly, but this disappears within a few weeks after the wood is added to the soil. Chief reason for the commonly observed harmful effect of sawdust or shavings on crops is the depletion of soil nitrogen.

Black plastic film may also be used as a mulch. See section below.

Plastic Film

For weed control in vine crops, you may want to consider the use of black plastic film as a mulching material. When rolled into place over the soil and properly anchored against wind, the mulch conserves soil moisture and prevents growth of weeds in the planting.

To use the plastic film, first prepare the soil for planting. Film either 3 or 4 feet in width can be used. Lay the film down the row area making 2 parallel trenches 3 inches



Black plastic film properly anchored against wind conserves moisture and helps prevent weed growth.

632

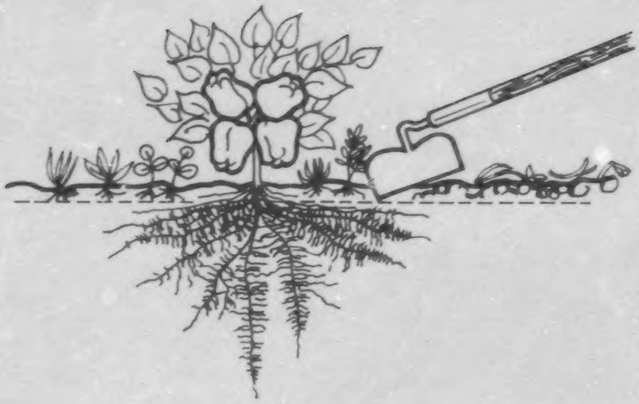


Fig. 10: Use very shallow cultivation to prevent damage to vegetable plant roots.

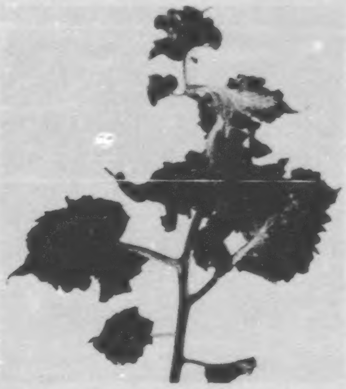
deep and 30 inches apart, if 36-inch width film is used, or 42 inches apart, if 48-inch width film is used. Center the film over the row and make trenches accordingly. Unroll the film over the row area to be planted, removing wrinkles and covering the edges of the film in the trenches with 3 inches of soil. Anchor the ends of the film against wind by trenching across the ends of the row and covering the film ends with at least 3 inches of soil.

At planting time, set plants through the plastic film by cutting holes just large enough to inject the plants. Be sure to set plants in the center of the film (in the row) and at the correct spacing. Refer to plant planting data in Table 3.

Cultivation

Cultivate unmulched areas to control weeds and to break up the crust which may form on heavy soils. Excessive cultivation results in loss of soil moisture during dry periods and is a waste of labor.

Always cultivate shallow. Roots of many vegetable plants grow very near the surface and spread out widely in every direction. Deep cultivation prunes any roots which lie in the zone of cultivation and reduces yield. Soils which become puddled during the early part of the season may be cultivated deeper while the plants are still small and the roots have not grown extensively. This practice improves aeration and helps restore the soil to good condition.



Drifting or improperly applied herbicides may severely damage or kill crop plants. Note typical symptoms of 2,4-D injury to tomato plant.

Instead of deep "chopping," the surface of the ground should be scraped with the hoe blade nearly parallel to the soil surface, Fig. 10. If a wheel hoe is used for cultivation, the sweep shovel should be used and adjusted to run level just beneath the surface of the ground. In case the garden is being cultivated with regular farm tools, sweep type shovels on the cultivator will be better than deep tillage tools.

Chemicals

Although research has led to the discovery and manufacture of many chemicals capable of controlling weeds without damage to desirable plants, there are many problems associated with the mechanics of using herbicides. Appropriate materials must be safely applied at the correct time and in the correct amounts if good weed control is to result without causing extensive damage to garden and landscape plants. Therefore, it is recommended that the chemicals be used only by highly experienced applicators.

A few of the problems associated with herbicides which make their use by home gardeners inadvisable at this time include the following:

1. There is no one herbicide available that can be safely used on all garden vegetable crops. A wide variety of vegetable crops are usually grown in the home garden. Thus, the home gardener would need to purchase, store, and safely use several different chemicals, which would be expensive.
2. The herbicide must be applied at the proper rate and at the right time if good weed control is to result without damage to crop plants. Equipment must be accurately calibrated to apply materials at the correct rate.

   Herbicides applied at incorrect rates produce undesirable results in at least two ways:
   - (a) Materials applied too lightly fail to give desired weed control. Money invested in the materials is wasted.
   - (b) Materials applied too heavily can severely damage or kill crop plants. Excessive herbicides in the soil, due to overuse, may cause injury to different crops planted in the soil in subsequent gardening seasons. This is also very costly.
3. In the case of some herbicides, caution must be used to prevent drift to adjacent areas. There are many cases where plants have been damaged by drifting herbicides. This sometimes results in legal action being taken against offenders.
4. There are some weeds which cannot be controlled by available herbicides except at rates which would also damage the crop plants.

   Despite the fact that herbicides cannot be recommended for use in the home garden at this time, there are several things the home gardener can do to control weeds. Mulches such as black plastic film, clean straw, sawdust, or peat moss properly applied are most valuable in weed control. Mulches conserve soil moisture and enable plants to make rapid growth, thus getting a good "headstart" on the weeds.

   Plant rows far enough apart to allow mechanical cultivation with garden tractors or tillers. Power equipment greatly reduces the drudgery of weed removal. Weeds are easier to remove when small than large.

Watering

Irrigation during dry periods improves yield and quality of all vegetables. Most vegetables require about one inch of water each week, but this varies according to temperature, soil type, wind conditions, and stage of development of the particular vegetable. Since the home gardener raises many different kinds of vegetables at different stages of maturity in the same area, the general rule of thumb is one inch of water per week.

Apply enough water to soak the soil to a depth of 6 or 7 inches at each application. Adjust the frequency of application to the rainfall. One application per week is usually enough. However, under high temperature and sandy soil conditions, more frequent applications are needed. Water may be applied with an ooze hose, sprinkler, or by running water along the rows from a hose.

Vegetable plants lacking the necessary moisture in the soil will show varying degrees of wilting, resulting in either a decreased growth rate or no growth at all. Such plants often appear to have a disease, do not utilize fertilizers in the soil near the plant roots, and often drop blossoms or young fruit.

Guard against keeping the soil soggy for several days at a time. Such conditions cause root systems to die or decay. Loss of a considerable portion of the root system soon becomes apparent in the top growth of the plant. Leaves turn yellow and often drop off, growth is stunted, and the plant often dies.

Cultural Suggestions

Asparagus: A popular crop in many home gardens, asparagus is a perennial crop planted along one side of the garden where it will not interfere with future seedbed preparation in the garden. In early spring, plant 1-year old crowns in a trench 8 inches deep and 12 inches wide with buds upright. Cover with no more than 2 inches of soil. Add the rest of the soil after the spears have emerged. Avoid poorly drained, acid soil. Apply lime so that the soil will be nearly neutral—pH 6.8 to 7.0.

A soil bed is produced when plants are spaced 18 inches apart each way.

For row plantings, make rows 5 feet apart and space crowns 14 to 18 inches apart in the row. If manure is available, start soil preparation a year ahead of planting Apply manure and lime, if needed, so that these materials will be incorporated throughout the top 12 to 14 inches of soil.

Do not cut spears until third year and then harvest for only 5 or 6 weeks or until spears become thin. In following years, the harvest season can be extended. The spears should be cut just under the surface of the soil.

Cut asparagus spears just under the surface of soil or snap them off just above the ground

Next year's crop depends upon fern growth made after harvest and before freezing weather occurs in fall. Allow the tops to remain on the plants over winter. Cut and remove the tops in the spring before new growth begins. Place tops in the compost pile, if not diseased. A liberal fertilizer program is necessary for rapid development of fern. Typical application on a silt loam soil is 25 to 30 pounds of 8-16-16 or equivalent per 1,000 square feet. Apply half of this in the early spring before harvest starts and the remainder after harvest. Additional nitrogen at the rate of 1 to 2 pounds of ammonium nitrate per 100 feet of row may be advisable.

Beans: The home gardener has a choice of many different kinds of beans. Snap beans and lima beans are the most popular, but other kinds can be tried.

Beans are a warm season crop, so do not plant until the soil is warm. Snap beans can be planted earlier than lima beans. Lima beans require warm weather. Seed treatment with one of the recommended fungicides is helpful. If seed maggot has been a problem, purchase seed that has been treated with an insecticide.

Plant in rows so cultivation can be done easily. Consider 24 inches between rows as a minimum. Crusts on heavy soils may prevent plant emergence unless broken just ahead of emergence.

Harvest snap beans before large seeds and fibrous matter develop in the pods. Do not handle plants when wet because diseases, especially anthracnose, may be spread. Pick lima beans when seeds are nearly full grown but well before pods turn yellow.

Harvest horticultural beans when the pods are brightly colored and before drying starts.

Plant snap beans every 2 to 3 weeks until mid-July for continuous supply. Two plantings of lima beans 3 weeks apart are usually satisfactory. Pole limas will extend the harvest period.

Start a thorough insect control program early. Get the latest recommendations from your county Extension office.

Beets: This vegetable can be sown in spring as soon as soil can be prepared. Additional plantings may be made until early June. Beets grow in both cool and warm seasons but color is better when temperatures are cool.

Beets make best growth in soils with ph 6.0 to 6.5.

Highly acid soils cause crop failures. Make mid-summer plantings in shallow trenches slightly deeper than those for spring seedings.

Upon germination, the beet fruit containing several seeds, produces a cluster of plants. These plants should be thinned to 1 or 2 inches apart as soon as rows can be seen.

Broccoli: For many years this crop was not raised in Ohio gardens, but with the development of better cultivars, broccoli has become popular. Raise the crop as an early spring crop or as a fall crop. Warm weather reduces quality.

In the spring, set plants as early as possible. Allow about 24 inches between plants in the row. A side-placed application of fertilizer high in nitrogen, like 12-12-12, at 1 to 2 pounds per 100 feet of row may be advisable soon after plants are set in garden.

Keep the flower heads harvested. Cut the heads when they are well formed but before buds start to show yellow color. Cut about 5 inches of stem. Harvest side shoots as they develop and before the buds show yellow color.

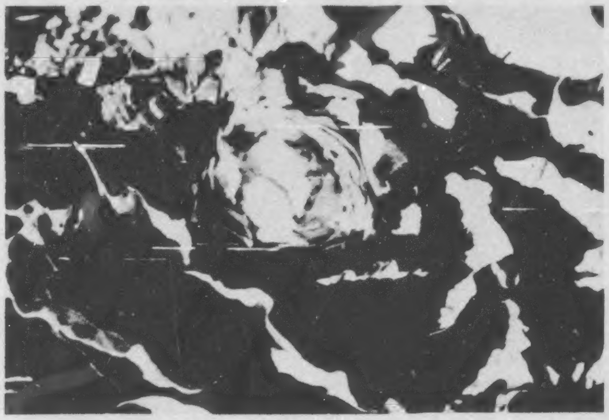
Sow seed for the fall crop in early June. Allow 4 to 5 weeks for plants to develop before transplanting. Some gardeners have been quite successful with direct seeding of broccoli.

Brussels Sprouts. This crop is difficult to grow, but with development of hybrids, the home gardener has a better chance of success. Grow the crop for fall harvest only. Sow seed in early June and transplant when plants are 5 to 6 inches tall. Allow about 30 inches between plants. Make rows at least 3 feet apart when hybrids are planted.

Aphids (plant lice) are usually severe and difficult to control. Imported cabbage worms and loopers are also troublesome. Get latest control recommendations from your county Extension agent.

Remove lower sprouts as soon as they are large enough for use. Lower leaves may be removed to allow more space for sprouts to develop. Allow top leaves to remain on the plant. Plants may be left in the garden until freezing weather occurs.

Cabbage: Cabbage tolerate more hot weather than broccoli, Brussels sprouts, or cauliflower. Grow early cabbage from plants. Set the plants in the garden as soon as weather permits. Late cabbage may be seeded in a row for later transplanting or may be direct seeded where the crop is to mature. The plants are then thinned to the correct stand. Place early cabbage plants 15 inches apart in row; late cabbage plants require more space—18 to 20 inches is usually adequate.



Cabbage heads not harvested at maturity may split or crack. Twist plant to break some of the roots, thus reducing some of the cracking.

Produce late cabbage for storage or for kraut. Select yellow-resistant strains, especially on plots where cabbage has been grown before.

Carrots: First plantings may be made as soon as soil can be worked. Carrot seed often germinates slowly. Therefore, mark the row by mixing a small quantity of radish seed with the carrot seed.

Later plantings can be made but usually will be less successful. Best color develops in roots during warm weather. A deep, well-drained, friable soil is necessary for long, smooth stems. Thin carrot seedlings when they are 2 to 3 inches tall. Allow 1 or 2 inches between the plants.

Cauliflower: The fall crop is recommended because hot, dry weather, which is prevalent when spring planted crop is maturing, is unfavorable for "heading." Set plants in early June so heads will form during cool, fall weather. Blanch by tying leaves over "heads" as soon as they begin to form or use new self-blanching cultivars. Watch development carefully. Blanching requires 3 to 14 days, depending upon weather. During hot weather, blanching occurs rapidly. Harvest heads or curds while they are still compact and before they become open or "ricey." Purple types may be satisfactorily grown in home gardens.

Celery: This crop is difficult to grow and generally is not recommended for the average home garden.

Chinese Cabbage: Grow only as a fall crop in Ohio since Chinese cabbage requires cool weather for heading and development of best quality. Sow seed in the garden in late July and thin to proper spacing when plants are 1 to 2 inches apart. Since this crop may follow early-planted vegetables, apply additional fertilizer unless heavy application was made in early spring.

Collards: This vegetable is nutritious and rather easy to grow. Sow early in spring and make additional plantings until August. When thinning the row, the entire top of plant may be used. If lower leaves are picked, upper leaves will develop for later use.

Sweet Corn: Sweet corn is one of the most popular of home garden crops. Although not adapted to small gardens, gardeners frequently sacrifice other crops to grow sweet corn. Grow two or more rows of each planting to insure pollination. Thin to 12 to 14 inches between plants to insure good sized ears. Do not remove suckers. Suckering may reduce yield, especially if done late in the season or during dry weather.

Make succession plantings from early May until mid-July. This will insure a steady supply. Many excellent hybrids are available. By selecting hybrids with early, mid-season, and late maturity ranges, the harvest season can be nearly continuous.

Harvest and use ears promptly to obtain finest quality. If ears cannot be used immediately after harvest, chill by immersing in ice water and refrigerate. Get latest insect control recommendations from your county Extension agent.

Cucumbers: This vine crop is a warm season crop relatively easy to grow if insects are controlled. Insects pre-

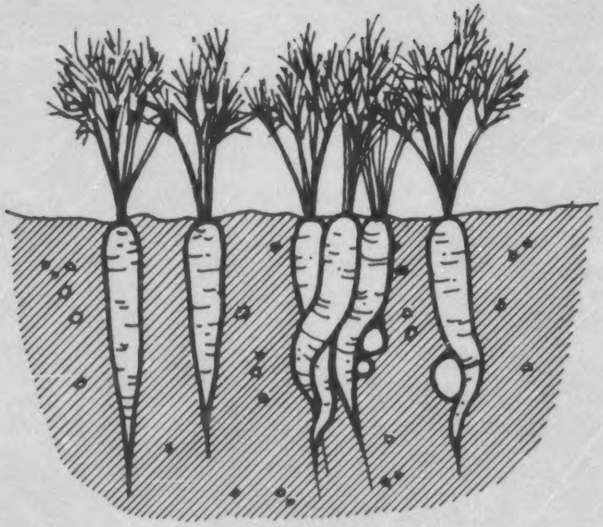


Fig. 11: Stones or lumps of soil may cause forked or misshapen roots. Failure to thin young carrots may cause root twisting.

sent one of the major problems in the production of this crop. Do not sow seed until the soil has started to warm. Germination is poor in cold soils. If garden area is limited, omit cucumbers or consider growing them on a trellis because they require considerable space.

Cucumbers respond to heavy fertilization and frequent applications of water. Harvest cucumbers while they are green or production will be reduced. Remove the cucumbers even if the family does not eat them.

Cucumbers will not cross-pollinate with melons or squash. However, bees are necessary for pollination of cucumber flowers. Gynoecious types can produce good yields of fruits starting early in the season.

Eggplant: This vegetable is a warm weather crop, and the planting date should not be rushed. Usually, 4 or 5 plants will supply enough fruit during the entire season for the average family. The vegetable requires a long growing season.

Harvest fruits when still shiny. In the fall, eggplants may be stored in a cool place for several weeks. Flea beetles damage plants and should be controlled with recommended insecticides beginning immediately after transplanting.

Endive: An easy crop to grow, sow endive seed in May or June for a fall crop. Sow in place and thin, or sow in a seed row and transplant. When plants reach maturity or in October, tie up leaves to blanch the heart if desired. Many prefer endive unblanched. The vegetable withstands considerable cold and may be used until winter, if covered with straw or leaves.

There are two general types of endive—the narrow leaf and the broad leaf (escarole). Finely curled types include Green Curled and White Curled. Broad leafed types include Full Heart Batavian and Cos Type Batavian. Use raw as salad or cooked as greens.

Kale: A member of the cabbage family, kale is relatively easy to grow. Sow as soon as ground can be worked in the spring. Another sowing can be made in July for the fall crop. It is hardy in most parts of Ohio and may be used all winter. Straw protection may be needed in northern areas. Harvest outer leaves or use entire plant. The plant should be thinned to stand 3 or 4 inches apart in a row.

Kohlrabi: This plant develops a thickened stem just above ground and has an appearance and taste similar to turnips. Use when stem is about 2 inches in diameter. It becomes woody and strong if too mature. Sow seed as early as soil can be worked and at intervals until late July. Thinning is necessary for highest quality. Both white and purple types are available.

Lettuce: Several different kinds of lettuce can be raised in Ohio gardens. Leaf, Bibb, Cos, Butterhead, and Crisp Head types of head lettuce can be grown, depending upon planting dates for each. Leaf lettuce, characterized by the loose, non-head forming leaves, can be seeded early in spring and will mature more quickly than other types. Most of the leaf lettuce cultivars mature in 45 to 50 days. Thin young plants 4 to 6 inches apart.

The Butterhead or Boston type of lettuce is well known for its high quality. White Boston is one of the favorite cultivars. The seed of these types can be sown in the garden early and then thinned to at least 12 inches apart in the row. Plants can be started in hotbed or greenhouse and then transplanted to the garden.

Bibb lettuce can be grown in Ohio gardens either as an early spring crop or as a fall crop. It cannot tolerate high temperatures like leaf lettuce. You may sow seed early and then thin to 7 inches between plants. Most success, however, is obtained by growing plants indoors and transplanting to the garden in the early spring. Summer Bibb will withstand higher temperatures.

The Crisp Head types of lettuce can also be raised in Ohio. Such lettuce is available on the market throughout the year. More time is needed to mature head lettuce than is needed for most other lettuce cultivars. Therefore, if plants can be secured, gardeners will want to set plants. Space plants 12 to 18 inches apart in the row. Set them in the garden as early as possible to insure heading before high temperatures of June. Ordinarily, the planting dates are in early April.

Kohlrabi has appearance and taste similar to turnips. Use when thickened stem is about 2-3 inches in diameter.

Muskmelon (Cantaloupe): Melons grow best in a fertile, sandy soil that holds moisture well. Melons are tender plants and should not be planted until frost danger is passed. For earlier maturing plants, sow 4 to 5 seeds in a berry box, plant band, or peat pot 4 weeks before safe planting date. Each box or pot makes one hill.

You get the best quality when the crop matures during warm, dry days and cool nights. Planting near cucumbers or squash will not cause poor flavor because cross-pollination does not occur. Cool, rainy weather when melons are maturing causes poor quality and sometimes off-flavors. Muskmelons are ready to pick when they separate easily from the stem. Striped and spotted cucumber beetles damage young plants. A thorough insect control program should be followed. Fungicides are valuable in protecting plant foliage throughout the season.

Okra: Okra (also known as "Gumbo") develops rapidly during hot weather. The crop requires as little as 4 to 6 days for pods to develop after flowers open. Pods are of best quality when 2 to 3 inches in length. You must harvest every 2 or 3 days to get this quality.

Onions: Grow onions from sets for green onions or an early-maturing crop. Onions can also be grown from seed. Sets or plants are now more practical. Sow seed in early spring. For dry onions, use only cultivars recommended for growing in northern areas as other types may fail to develop desirable bulbs.

When tops break over, dig and dry the onions in well ventilated area before storing. Onion tops should not be broken down deliberately.

Sweet Spanish onions are frequently grown from plants. Perennial onions such as Potato (Multiplier) and Egyptian (Topset) may be fall planted. Perennial onions provide very early green onions the following spring.

Parsnips: Sow seed as soon as ground can be worked. Radish seed may be mixed in to mark the row as seed of parsnips are slow to germinate. For best results, grow the crop on a deep, well-drained, fertile soil. The quality is improved by freezing. Leave the parsnips in the ground through the winter or dig in early winter and store as other root crops.

Peas: Early cultivars of peas and early sowing are essential for success. Make first plantings as soon as ground can be worked and follow with 1 or 2 more plantings at weekly intervals.

For freezing, select varieties that are especially well suited for this purpose. If soil is not weedy, try double rows 6 inches apart. Peas may benefit from innoculation with proper legume culture, available from garden supply stores.

If possible, plant peas in a different part of the garden each year, since this may help to reduce disease problems.

Peppers: Select varieties resistant to or tolerant to mosaic, a virus disease. Peppers are very tender and should not be set in the garden until all danger of frost is passed. Well-grown plants start producing in July and bear until frost. Peppers may be used either green or ripe, although the green stage is usually preferred. Popular peppers include bell, sweet banana, pimento, and hot types.

Potatoes: Potatoes grow and produce well only when soil is loose and well-drained, and when plants are dusted or sprayed regularly to control insects and prevent diseases. Use certified seed to reduce seedborne disease. The seed balls appearing on plants during mid-summer are worthless. Early cultivars are suggested for home gardens.

Pumpkins: Do not grow pumpkins unless the garden area is large. Sow 4 to 6 seeds per hill and thin to 3 plants. Allow 8 to 10 feet between hills and 10 to 12 feet between the rows. Harvest when shell is hard or just before heavy frost.

Radishes: Cool weather is essential for highest radish quality. Seed several feet of row every 10 days in spring and early fall. Do not sow seed too thickly. Many excellent cultivars are available.

Rhubarb: A perennial crop propagated by divisions of the old plant. Plant rhubarb at the side of the garden and set crowns just at the surface of the soil. Avoid poorly drained spots where water may stand. Fertilizer or manure applied at the end of the harvest season will help. Do not harvest the first year. Harvesting after the first year may continue until late June.

If petioles (stems) become thin, likely the plant should be divided. Lack of fertility can also cause thin stems.

Rutabaga: Similar to turnips, except for planting date. Sow rutabaga in late June or early July. This crop does best in the northern part of the state. It will stand some frost but should be dug before the ground freezes.

Spinach: Sow spinach seed very early in the spring or in the early fall, as spinach goes to seed and is of poor quality when maturing in warm weather. Apply lime if needed, since the crop makes best growth when in pH 6.2 to 6.8 range. Thin plants to 1 or 2 inches apart. For summer use, grow New Zealand spinach.

Squash: Bush squash types take much less space than vine types. Many excellent hybrids are available. Bush squash may be planted in hills 4 feet apart each way, or in 4-foot rows with plants 36 inches apart in the row. The vining types should be planted in rows that are 6 to 8 feet apart, and the plants should stand 60 inches apart in

Remove rhubarb seed stalks as they appear because they can reduce the vegetative growth of plant.

the row. Harvest and use summer squash in the immature stage. Use winter squash in the mature stage.

Sweet Potatoes: Set plants after soil is warm (early June). High ridging is not advised except on heavy, poorly-drained soils. Harvest as soon as vines are killed by frost. Handle roots carefully. After harvest, cure roots in a warm place for 2 to 3 weeks before storing.

Avoid excessive use of nitrogen fertilizers and/or manure. Too much nitrogen will cause heavy vine growth and poorly-shaped roots.

Tomatoes: Tomatoes can be grown in several sizes, shapes, and colors depending upon the cultivars planted. Tomato fruit may be red, yellow, orange, or pink in color and round, slightly flattened, globe, or pear-like in shape. Some cultivars have the potential to develop large fruit under favorable growing conditions; other cultivars such as the small cherry type develop only small size fruit because of genetic control of fruit size.

Top quality tomato plants for transplanting into the garden are green in color, about 8 to 10 inches tall, with straight, sturdy stems about the size of a lead pencil. The plants should have a healthy, extensive root system and large, fully expanded leaves free of insects and diseases. Plants available in individual pots can be transplanted with the least amount of transplant shock and will become more quickly established than those where the root system is disturbed in the planting operation.

Select a deep, loamy soil, well drained and well supplied with organic matter and plant nutrients. The crop will grow best in a slightly acid soil, pH 6.2 to 6.8.

As caged unstaked plants, set the plants 3 feet apart in rows 4 to 5 feet apart. Set plants to be staked 2 feet apart in rows 3 to 4 feet apart. Caged tomatoes should be spaced 2-3 feet apart in rows at least 5 feet apart depending upon cultivation method.

Turnips: Turnips will do best as a fall crop. However, they can be seeded in the early spring and harvested when roots are 1 to 2 inches in diameter. For best results, sow seed in late July or early August. Leave turnips in the ground until freezing weather, after which the roots may be stored.

Watermelon: Watermelon culture is similar to muskmelon and other vine crops. Both seedless and small fruited varieties or "ice box types" are available. Grow early cultivars and allow them to ripen on the vine. The older cultivars with large vines are practical only where space is unlimited. Some of the newer cultivars require less space.

Vegetable Storage

A well-planned family garden can produce more vegetables than the family might consume during the harvest period. A home storage will help extend the supply of these vegetables for the family.

Store only vegetables of good quality. Select mature, but not over-ripe, vegetables that are free from insect and disease injury. Some vegetables should be stored before they reach full maturity. Examples are carrots, beets, turnips, and parsnips. These vegetables tend to become woody at maturity.

Most vegetables will keep best if temperatures are maintained at 32 to 34 degrees F., with humidity as high as possible without moisture condensation. Exceptions to this rule include tomatoes, peppers, cucumbers, squash, and melons which should be stored at higher temperatures (45° F.) to avoid chilling injury.

Cabbage, carrots, beets, celery, endive, kohlrabi, persnips, and salsify store best at low temperatures (32° and 34°) with high humidity. Store Irish potatoes at 45 degrees to 50 degrees with high humidity.

Insect & Disease Control

The control of insects and the prevention of diseases is essential for successful gardening. Many new pesticides are appearing on the market for home vegetable gardeners. Contact your county Extension office for latest recommendations.

Gardening Vocabulary

The words given below are frequently used in gardening literature. They are explained to assist the reader in making more effective use of this publication.

Acid soil—any soil with a pH below 7, see Fig. 4.

Alkaline soil—any soil with a pH above 7, see Fig. 4.

Annual plant—a plant living one year or less. During this time, the plant grows, blooms, produces seeds, and dies (i.e. bean, sweet corn, cucumber, melon).

Biennial plant—a plant which requires 2 years or parts of 2 years to complete its life cycle (i.e. beet, carrot, cabbage).

Blanching—preventing sunlight from striking a plant part. As a result, the part is white in color.

Bolting—the production of a seed stalk by vegetable plants such as spinach, lettuce, or radish. Bolting by these crops in the garden is undesirable. Bolting occurs when days are long and temperatures are warm.

Broadcasting—scattering a material such as fertilizer or seed evenly over a soil surface.

Bulb—a plant structure made up of a short, fleshy stem, containing a growing point or flower bud. The stem is enclosed by thick, fleshy scales.

Companion crops—crops which have different harvest dates but are grown in the same area. One crop is harvested and removed by the time the other crop requires the growing space.

Compost—material resulting from the breakdown and decay of organic materials piled up in layers alternated with soil and fertilizer.

Cool season plant—a plant which makes its best growth and produces the highest quality crop when grown at cool temperatures (45° to 60° F.).

Cover crop—usually a grass type crop planted in a garden area to protect the soil from being carried away during months when the area cannot be used as a garden. The cover crops also add valuable organic matter when turned under by plowing in the spring.

Crown—the part of the plant where the stem and root join.

Cultivar—a term meaning cultivated variety now used in place of the word variety to indicate a specific type of horticultural plant. Cultivars may differ in growth habit, season of maturity, fruit color, fruit shape, etc. Example—Detroit Dark Red, Kathadin.

Cultivation—the loosening of a soil with either a hand or mechanical type implement chiefly for the purpose of controlling weeds.

Cultural practice—a specialized activity used in growing plants (i.e. pruning, cultivation, watering).

Edible plant part—a plant part which can safely be eaten for food.

Fertilizer—a material which provides one or more nutrients in forms which can be used by plants in growing.

Foliage—a name used to refer to the leaves of a plant.

Fungicide—a chemical material used to retard or prevent the growth of fungi.

Growing season—the period of time from the last plant killing frost in the spring to the first plant killing frost in the fall.

Gynoecious—Gynoecious cucumber plants produce mostly all female flowers. Such plants can produce heavy yields beginning early in the season.

Hardening—a process of slowing plant growth by withholding water, lowering the temperature, or gradually shifting the plants from a more sheltered environment to a less sheltered environment. The process of hardening plants is used to increase chances for survival at transplanting time.

Hardy plant—a plant which can be planted before the last killing frost in the spring.

Heavy Soil—a soil usually difficult to work. Clay soils are considered to be heavy soils.

Herbaceous plant—a plant described as having a soft, nonwoody stem. Generally, these plants live and grow for only one season.

Herbicide—a chemical material used to kill weeds.

Hill—a mound of soil in which several vegetable seeds are planted.

Hybrid—a plant resulting from crossing 2 plants of the same type which have different individual characteristics for a trait (i.e., tall or short for the height trait).

Innoculant—a black powder-like material applied to seed coats of legume seed prior to planting in the garden so as to insure the presence of nitrifying bacteria in the soil.

Insecticide—a chemical material used to kill insects.

Irrigation—artificially applying water to the soil during periods when natural rainfall does not fall in enough volume to maintain a desirable level of soil moisture for plant growth.

Legume—a plant whose root system is invaded by nitrifying bacteria which convert nitrogen into forms which can be utilized by the plant in growing.

Light soil—a soil easy to work. Sandy soils are considered to be light soils.

Lime—a material used to decrease soil acidity and supply amounts of calcium and magnesium required by growing plants.

Loam soil—a soil made up of about equal parts of sand, silt, and clay sized soil particles. This composition provides a good soil structure suitable for plant growth.

Long season crop—a crop which requires a maximum of frost free days to produce a satisfactory crop.

Mulch—a material applied to the soil surface to conserve soil moisture, maintain a more even soil temperature, and/or aid in weed control.

Organic matter—a soil component resulting from the decay of plant and animal materials.

Perennial plant—a plant which normally lives more than two years.

pH scale—a scale used to report the degree of soil acidity or alkalinity.

Plant nutrient—one of the 16 chemical elements currently known as essential to plant growth.

Plant spacing—the distance in inches or feet between individual plants growing in a row.

Pruning—the wise removal of plant parts to obtain a more desirable plant.

Puddled soil—a soil which has been worked while too wet with the result that it has a greatly reduced amount of pore space.

Row spacing—the distance in inches or feet between plant rows.

Seedbed—the name given to a garden soil prepared to receive seed or plants as a result of plowing and disking, tilling or spading, and raking.

Seed germination—the beginning of growth of the young plant in a seed when heat, moisture, and air is provided.

Seedling—the young plant emerging from a germinating seed.

Short season crop—a crop which grows and produces its harvest within one or two months.

Side dressing—applying fertilizers along the side of plants after they are established and growing.

Soil borne fungi—small, non-green plants which live in the soil and capable of causing plant disease.

Soil crusting—the formation of a thick hard layer of soil on the soil surface as a result of the impact of many rain drops during a heavy rainfall.

Soil improvement—making soils more productive by such practices as adding organic matter, fertilizers, and lime.

Starter solution—a liquid fertilizer applied to the base of transplanted plants to promote rapid establishment and growth.

Succession crops—crops which are planted in a garden area after crops previously growing in the area are harvested and removed.

Tender plant—a plant which is injured or killed by even a light frost.

Thinning—the removal of some plants from a row so that the remaining plants will have more room to grow and develop.

Toxic material—a poisonous material capable of severely damaging or killing a plant.

Transplant—a plant produced from seed germinated in a favorable environment for later planting in an area where the plant is to grow to maturity.

Tuber—a short end part of an underground stem which becomes thickened with the accumulation of food materials.

Viable seed—a seed containing a small living plant which will begin to grow once conditions necessary for germination (sprouting) are provided.

Variety—See Cultivar.

Weed—a plant growing out of place.

Table 5: Common Gardening Problems

Symptoms	Possible Cause	Corrective Action
Plants stunted in growth, sickly yellow in color	Plants growing in compacted or poorly drained soil	Modify soils with organic matter or coarse sand prior to planting crops
	Lack of soil fertility or undesirable pH	Use lime and fertilizer according to soil test results or use fertilizer at rate of 2-3 pounds of complete fertilizer per 100 square feet in absence of soil test
	Insect or disease injury	Use a regular spraying or dusting program with general purpose spray or dust materials
	Low temperature	Plant warm season crops after all danger of frost has past and air temperatures are warm (65-80°F.)
	Plants resulting from poor quality seed or transplants	Use only high quality seed and plants for gardening. Do not use seed saved from previous crops
Holes in plant leaves or leaves yellowish in color and distorted in shape	Damage by chewing- and sucking-type insects	Use recommended insecticides for the home garden
Plants with weak root systems	Poor drainage, insect or nematode damage, disease	Use drain tile, improve soil structure with organic matter and coarse sand or change garden location; use recommended soil insecticides and crop cultivars
Plants tall, spindly, unproductive	Excessive shade from tall plants, buildings or weeds	Change garden location to a sunny area, keep garden free of weeds
Lack of growth, plant wilting	Deficient soil moisture supply	Maintain soil in a moist, not soggy condition by use of mulches or irrigation
Blossom Drop	Low moisture supply in soil with blossoms exposed to hot drying winds	Use a 3-4 inch mulch around plants to conserve soil moisture; apply the mulch when the soil is moist
	Cultivar is of type which drops blossoms	Use only recommended cultivars for the growing area; don't save seed from fruit for starting next season's plants
	Low night temperatures (several nights in a row when temperature is below 60° F.)	Avoid planting too early in the spring
	Too much nitrogen in the soil	Avoid using high nitrogen fertilizers in the area where tomatoes are to be grown
	Overwatering	Avoid keeping soil in a soggy condition by excessive watering
	Disease (Early Blight, Septoria Leaf Spot)	Use recommended fungicides
	Insect removal of blossoms	Identify the insect doing the damage and apply recommended insecticide or remove insects by hand and destroy
Tomato leaf roll	Excessive soil moisture	Avoid overwatering
	Excessive accumulation of food materials in the leaves	None
	Excessive pruning (suckering)	Remove suckers when very small (1-2 inches)
	Disease	Use recommended varieties
Sudden wilting and death of tomato plants usually when the first flower clusters have set fruit	Toxic substances produced by nearby Walnut tree	Plant tomato plants at least 50 feet from Walnut tree
Downward curvature of young leaflets, prominent light colored veins, rolled edges, distorted leaf surfaces, and sharp pointed leaflets	2,4-D injury	Avoid use of 2,4-D near the garden area
Plant leaves with white, powdery covering, rust streaks, various types of spots or dead and dried areas	Plant disease	Use resistant cultivars; remove diseased plants from garden; practice crop rotation; use fungicide sprays or dusts; control disease transmitting insects
Large, dry, brown, leathery, scab-like blemish of the blossom end of a fruit	Blossom end rot	Avoid overwatering, excessive use of nitrogen fertilizer, and frequent deep cultivation; maintain a uniform soil moisture supply by using mulches or watering

SEASONAL AVAILABILITY OF PRINCIPAL OUTDOOR-GROWN VEGETABLES AND POTATOES

Vegetable	Begins	Most Active	Ends
Asparagus	April 25	May 10-June 15	June 30
Beans, Lima	July 10	July 25-Sept. 15	Oct. 1
Beans, Snap	June 25	July 1-Sept. 30	Oct. 25*
Beans, Horticultural	July 10	July 15-Sept. 15	Oct. 1
Beans, pole	July 10	July 20-Oct. 1	Oct. 15*
Beets	June 1	Continuous	Oct. 15
Broccoli			
Early Summer	June 15	June 15-25	July 1
Late Summer	Sept. 15	Sept. 15-Oct. 15	Nov. 15
Cabbage			
Late Spring	May 25	June 1-July 1	July 15
Early Summer	July 1	July 15-Sept. 15	Sept. 30
Early Fall	Oct. 1	Oct. 1-Oct. 31	Nov. 30
Carrots	July 1	Aug. 1-Sept. 30	Oct. 31
Cauliflower	Sept. 1	Sept. 15-Nov. 15	Nov. 30
Celery			
Early Summer	June 15	July 1-Aug. 31	Aug. 31
Early Fall	Sept. 1	Sept. 1-Oct. 31	Nov. 15
Collards	May 15	June 1-Nov. 1	Dec. 1
Corn, Sweet	July 1	July 20-Sept. 15	Oct. 10*
Cucumbers	July 1	July 15-Sept. 15	Oct. 1*
Eggplant	July 10	July 25-Sept. 15	Oct. 15*
Endive & Escarole	June 10	July 1-Aug. 15	Nov. 15
Kale	April 15	May 15-Sept. 15	Dec. 1
Lettuce (primarily from muck areas)			
Bibb	June 15	July 1-Aug. 15	Sept. 15
Head	June 10	June 15-June 25	July 1
Leaf	May 20	Continues until Fall	
Romaine	June 15	Continues until Fall	
Muskmelon	July 15	Aug. 15-Sept. 15	Oct. 1
Mustard	May 15	June 1-Sept. 15	Oct. 15*
Okra	July 15	Aug. 1-Aug. 30	Oct. 1*
Onions, green	May 5	June 1-Sept. 30	Oct. 15
Onions, dry	July 15	Aug. 1-Oct. 15	Storage
Peas, green	June 20	June 20-July 1	July 1
Peppers, hot	July 20	Aug. 1-Sept. 30	Oct. 25*
Peppers, sweet	July 20	Aug. 1-Sept. 30	Oct. 25*
Potatoes, Irish	July 10	July 20-Oct. 15	Storage
Pumpkins	Sept. 15	Oct. 1-Oct. 15	Oct. 30
Radishes	May 15	June 1-Sept. 15	Oct. 1
Rhubarb	April 20	May 1-June 15	July 1
Spinach, Spring	April 15	May 1-June 30	July 31
Spinach, Early Fall	Aug. 1	Aug. 15-Oct. 15	Dec. 10
Squash, Summer	July 1	July 10-Sept. 15	Nov. 15
Tomatoes	July 1	July 10-Sept. 30	Oct. 31*
Turnips, Fall	Aug. 20	Sept. 1-Apr. 15 (Storage)	
Turnip greens	May 15	June 1-Oct. 1	Nov. 1
Watermelon	Aug. 20	Sept. 1-Sept. 20	Oct. 1

* Early frosts in Fall can affect supply.

APPENDIX B

INSTRUCTIONAL MATERIALS

HANDOUTS

H-1: PRODUCING HORTICULTURAL PLANTS FROM SEED

H-2: DESIRABLE PRACTICES

H-3: VEGETABLE VARIETIES FOR OHIO HOME GARDENS

H-4: HOME VEGETABLE GARDEN INSECT CONTROL

TRANSPARENCIES

T-1: SAMPLE FAMILY VEGETABLE GARDEN PLANT

T-2: SEED IDENTIFICATION

T-3: pH SCALE

T-4: STARTER FERTILIZER

T-5: LIMING

T-6: ORGANIC FERTILIZER

T-7: PLANT NUTRIENTS

T-8: ESSENTIAL GARDENING OPERATIONS

T-9: MINIMUM TOOLS AND SUPPLIES

T-10: SEED FURROW IN RELATION TO SEED SIZE

T-11: PLASTIC MULCH

T-12: MULCH

Producing Horticultural
Plants from Seed

Prepared by:

James D. Utzinger
Extension Horticulturist
The Ohio State University

Introduction

Many horticultural plants are started from seed. In order to be successful in starting plants in this way, it is necessary to have basic information about seeds, the procedures by which they can be germinated, and the environmental factors which must be provided to maintain healthy seedlings after germination. Information presented below has been prepared to assist interested persons in starting plants from seed.

The Nature of Seeds

Basically seeds consist of a seed coat, a supply of stored food, and a small plant, known as an embryo. It is important that the embryo in the seed be alive; otherwise the seed will not germinate. The reserve food supply furnishes nourishment to the seedling plants until it produces its own food supply through the process of photosynthesis. The seed coat protects the embryo from drying and injury.

High quality seeds have living embryos and high germination percentage, produce plants true to varietal type, and are clean and free of disease causing organisms. Seeds have a high germination percentage when most of the seeds sown begin to grow. Nine seedlings growing from 10 sown seeds is an example of a high germination percentage (90%). Four seedlings resulting from 10 sown seeds is an example of a poor germination percentage (40%). A high germination percentage cannot be expected from poor seed, so obtain and use only the best seeds for starting plants.

Germination

Germination is the process by which the embryo or miniature plant within the seed begins to grow. Certain environmental conditions must exist to initiate the germination process.

The young plant developing from the embryo after germination is called a seedling. The following events occur during germination, resulting in the emergence of seedlings:

1. The seed absorbs water.
2. The seed coat softens and swells.
3. The seed coat splits as a result of the increase of pressure as water is absorbed in the seed.
4. The primary root emerges through the split and grows downward to form the root system of the seedling.
5. The upper part of the embryo (cotyledons, hypocotyl and epicotyl) emerges from the germinating medium.
6. The true leaves (plumule) unroll or unfold exposing the growth bud from which growth proceeds.

In order for seed to germinate, there must be a living embryo in the seed, the temperature must be sufficiently high, sufficient but not excessive, moisture must be present, and a supply of air necessary for the energy release process in the embryo must exist.

Moisture As A Factor In Germination

Enough moisture must be present so that the seed absorbs sufficient water to soften and break the seed coat as swelling occurs. Water is also required for the digestion of the stored food supply, providing the required nutrition for the developing seedling. Excessive moisture in the germinating medium can result in seed rot or in unhealthy seedlings if germination occurs at all. Too little moisture can result in excessive drying and germination failure. Once germination begins, the seed must not be allowed to dry out at any time.

Providing the proper amount of moisture to the seed for the germination process is one of the critical factors in achieving satisfactory germination.

Experience is a valuable aid in determining the proper amount of moisture to provide the seeds to be germinated; therefore, profit from observation and experience gained when germinating each lot of seed.

Temperature As A Factor in Germination

A sufficient amount of heat must be present for seed germination to occur. Seeds vary as to their temperature requirements for germination. Some seeds require higher temperatures than others for satisfactory germination. Recommended temperatures for the germination of seeds of several horticultural crops are found in Table 1.

Oxygen As A Factor in Germination

In order for satisfactory seed germination to occur, there must be air present to provide the oxygen necessary for the energy releasing process (respiration) in the living cells of the embryo. Lack of air can prevent the normal germination process from occurring and the seeds may decay.

Light As A Factor in Germination

For some horticultural seeds to germinate, exposure to light is necessary. Seeds having a light requirement for best germination are indicated in Table 1.

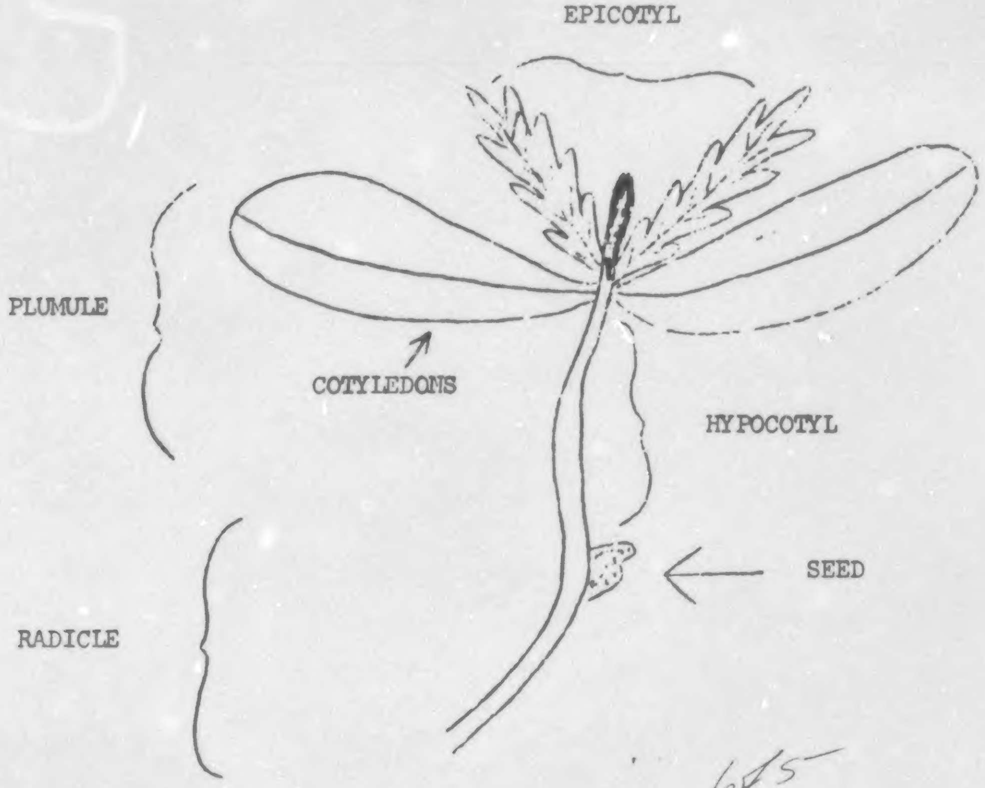


TABLE 1

Temperature and Light Requirements for Germinating Seeds of Several Horticultural Crops

Crop	Temperature Range for Germination (°F)	Best Temperature for Germination (°F)	Germination Benefited by Seed Exposure to Light
Cabbage	45-95	85	No
Pepper	65-95	85	No
Muskmelon	75-95	90	No
Tomato	60-85	85	No
Watermelon	70-95	95	No
Ageratum (Blue mink)	70-75	70	Yes
Alyssum (Carpet of Snow)	65-75	70	No
Begonia (fibrous rooted)	65-75	70	Yes
Celosia	70-75	70	No
Coleus (Red-Rainbow)	65-75	65	Yes
Geranium		70	No
Marigold	65-75	70	No
Petunia	65-75	70	Yes
Portulaca		70	No
Salvia	70-75	70	Yes
Snapdragon	65-75	65	Yes
Zinnia	70-75	70	No

Common Causes of Germination Failure

A number of factors can lead to germination failure. These include the following:

1. Damaged seed - Seed with broken seed coats, or with insect, rodent or heat damage may not germinate satisfactorily.
2. Old seed - Many seeds over two years old may not germinate well, especially if stored under hot, moist conditions.
3. Soil or media too wet - Too much water can prevent air from moving around the seed causing decay before the seedling emerges. Excessive moisture can also encourage disease such as damping off in the seedlings after germination.
4. Hard seed - Some plants produce seeds with a tough coat which will not allow moisture to enter the seed. In such cases it is necessary to weaken the outer seed coat (scarification) so that water may be absorbed to begin the process of germination.

Seeding Procedures

Seed may be either broadcast or sown in rows with good results. Seedlings in rows are easier to handle and dampiing off is somewhat easier to control.

The germinating medium should be watered and allowed to drain free of excess moisture well ahead of sowing time.

Sow the seed by broadcasting or seeding in rows as preferred. , Very small seeds need not be covered. Larger seeds may be covered up to one half inch deep or deeper depending upon seed size.

After sowing, a very light misting will be sufficient watering if the medium was well moistened previously. Place a pane of glass or plastic bag over the seeded flat and place it in an area where the optimum temperature for germination, see Table 1, can be maintained. If the seed does not have a light requirement for germination, it can be put in a dark place as necessary to obtain the optimum germination temperature. Do not seed different kinds of seeds in the same flat as one type of seed may germinate well ahead of the other making it impossible to maintain favorable environmental conditions for both the germinated and ungerminated seed in the flat.

Remove the plastic bag or glass as soon as the seed is germinated. Keep the seedlings as dry as possible without wilting and expose them to a gradually increasing amount of light; otherwise the seedlings will become tall and spindly.

Transplant the seedlings as soon as the first true leaves appear. You now have brought the seedlings to a stage where they are handled as transplants.

# # #

DESIRABLE PRACTICES

1. Use mulches to conserve moisture, control weeds, and reduce the amount of fruit rot.
2. Keep plants free of insect and disease damage.
3. Examine garden plants regularly to detect problems early.
4. Keep garden weed free.
5. Remove tomato suckers when small (one or two inches long), if plants are staked and tied.
6. Sample the soil and have it tested at least once every 3 years.
7. Apply fertilizer and lime to vegetable crop soils using soil test results as guide.
8. Thin thickly seeded row crops so that remaining plants will have more growing space.
9. Drive tomato stakes into the soil soon after plants have been set rather than waiting until plants have become well established.
10. Avoid walking and working in the garden when the soil and plant foliage is extremely wet.
11. Use mulch materials free of weed seeds.
12. Keep materials well agitated in the sprayer tank.

UNDESIRABLE PRACTICES

1. Cultivating so deeply that many plants roots are removed or severely damaged.
2. Keeping the soil in a wet, soggy condition by excessive watering.
3. Applying pesticides to vegetable plants without reading directions on the chemical container or observing safety precautions.
4. Using cultivars not suited to the locality.
5. Allowing weeds to take over the garden.

6. Mounding the soil up around plants so that rainfall drains away from the root system rather than soaking in next to the plant.

7. Planting the rows too close together so that it is difficult to get a cultivator between the rows without damaging the plants.

8. Tying the tomato stem so tightly to the stake that the developing fruits are damaged by rubbing the stake.

9. Placing a handful of fertilizer in the hole where the tomato plant is to be set.

10. Failing to have the soil tested at least every 3-4 years.

11. Using lawn fertilizers containing herbicides in the garden.

OPERATIVE EXTENSION SERVICE
THE OHIO STATE UNIVERSITY

VEGETABLE VARIETIES FOR OHIO HOME GARDENS

Prepared by a committee composed of the following: **William M. Brooks, Margaret Coon, William L. George, James D. Utzinger, E. C. Wittmeyer and E. K. Alban, Department of Horticulture.**

VEGETABLE VARIETIES*

Many improvements have been made in vegetable varieties in recent years. These improvements include higher yields, deeper color, better flavor, less fiber, more uniform maturity, better general appearance, less waste, and improved disease, insect and nematode resistance. However, some of the older standard varieties are excellent and should not be discarded just because newer ones have appeared.

When selecting a variety, consider the following points:

1. **Past Experience**—Consider past experiences with particular varieties. Soil and climatic conditions affect the growth and performance of specific varieties.

2. **Intended Use**—Some varieties are more suitable for freezing than others. Those suitable for freezing and those that have done well under Ohio conditions are marked with an asterisk (*). In general, varieties that are suitable for fresh use are usually acceptable for canning if harvested at the proper stage of maturity.

3. **Maturity Range**—Vegetable varieties often vary in maturity range. Most seed catalogues contain information on approximate number of days needed for maturity. If you have a freezer, you may be less concerned about maturity ranges than the family which does not freeze vegetables. Gardeners can extend the harvest period by selecting varieties with different maturity periods or by making successive plantings.

4. **Disease and Nematode Resistance**—No variety is resistant to all diseases. However, a particular variety may be resistant to one or more diseases and/or nematodes. Many of the seed catalogues contain this information. The varieties listed here are examples of vegetable varieties that are resistant to diseases and/or nematodes as indicated. Many other examples could be cited.

Vegetable Varieties Resistant to Diseases or Nematodes

Vegetable	Variety	Resistant to these Diseases or Nematodes
Snap bean	Tendercrop	Common virus diseases
Cabbage	Marion Market	Cabbage yellows
Cucumber	Gemini 7	Scab and Mosaic
	SMR 18	Scab and Mosaic
Muskmelon	Harper Hybrid	Fusarium wilt
	Harvest Queen	Fusarium wilt
Peas	Freezonian	Fusarium wilt
Tomato	Jetstar	Fusarium and Verticillium wilt
	Better Boy	Fusarium and Verticillium wilt and Nematodes

5. **New Varieties**—Many new varieties are appearing each year. Some of these offer possibilities for Ohio gardeners. You may want to compare one or more new varieties with some of the well established varieties suggested in this leaflet.

---

* Variety, as used in this publication, refers to a cultivated variety (cultivar). The term cultivar was adopted by the International Code of Nomenclature of Cultivated Plants, 1961.

650

Varieties Suggested for Home Vegetable Gardens

Varieties marked with an asterisk (*) are suitable for freezing as well as for fresh use.

Asparagus
Mary Washington*, Waltham Washington*

Beans
bush green—Stringless Green Pod*, Tendergreen*, Topcrop, Tendercrop*. Provider, Tenderette, Executive, Romano*, Bountiful
bush, wax—Cherokee Wax*, Kidney Wax (Brittle Wax*), King Horn Wax, Earliwax, R.P.
pole, green—Kentucky Wonder*, Blue Lake, Romano*
pole, wax—Kentucky Wonder Wax
pole, lima—King of the Garden, Burpee's Best (Challenger)
bush, lima—Fordhook*, Baby Fordhook, Fordhook 242*, Thaxter
green, shell—French Horticultural*
dry or navy—Michelite, White Kidney

Beets
Early Wonder, Detroit Dark Red Strains*, Ruby Queen, Burpee Golden (yellow)

Broccoli
Italian Green Sprouting (Calabrese)*, Waltham 29 (fall)*, DiCicco, Green Mountain (spring), Green Comet

Brussels Sprouts
Long Island Improved*, Jade Cross Hybrid*

Chinese Cabbage
Michihili

Cabbage
early—Golden Acre Yellows Resistant, Stonehead, Early Jersey Wakefield, Jersey Queen (Y.R.)
midseason—Marion Market, Market Prize, Round Up
late—Danish Ballhead, Mammoth Red Rock, Wisconsin All Seasons
red—Ruby Ball, Red Acre
savoy—Savoy King (mid-summer and late), Vanguard
flat—Flat Dutch

Cauliflower
Early Snowball*, Snowball Imperial (fall), Snowdrift* (fall), Early Purple*, Snowball Y, Self-Blanche

Carrots
Nantes (Touchon)*, Danvers Half Long, Imperator, Gold Pak, Red Cored Chantenay Strains*, Pioneer

Celery
golden—Golden Self-Blanching
green—Summer Pascal, Utah 52-70, Green Light (fall only), Florida 683

Chard, Swiss
Lucullus (green ribbed), Rhubarb (pink ribbed), Fordhook Giant (white ribbed)

Collards
Vates (Improved Georgia type), Georgia or Southern

Corn, Sweet
early and medium early—Earliking, Spring Gold, Northern Belle, Bravo, Sundance
midseason—Gold Cup*, Golden Cross Bantam*, Seneca Chief*, Victory Golden*, NK-199*, Jubilee*, Merit*
late—Honeycross*, Iochief*, Silver Queen* (white), Seneca Scout, Apache
mixed white and yellow kernels—Honey and Cream, Butter and Sugar, Gleam and Gold, Sprite

Cucumber
slicing—Burpee Hybrid, Straight Eight, Marketmore 70, Gemini 7 (Gynoecious), Tablegreen, Victory (Gynoecious), Meridian (Gynoecious), Burpless No. 26, Sweet Slice
pickling—National Pickling, Wisconsin SMR 18, Pioneer, Premier, Mariner, Pickmore

Eggplant
Black Beauty, Burpee Hybrid, Black Magic Hybrid, Classic Hybrid

Endive and Escarole
Full Heart Batavian (Broad Leaf), Green Curled (green ribbed), Salad King

Kale
Dwarf Blue Curled*, Dwarf Green Scotch Curled, Dwarf Siberian, Vates*

Kohlrabi
Early White Vienna, Purple Vienna

Lettuce
leaf—Salad Bowl, Grand Rapids, Black Seeded Simpson, Slobolt, Oak Leaf, Matchless (Deer Tongue), Ruby, Green Ice
Butterhead—Bibb, Buttercrunch, Summer Bibb
Romaine—Parris Island
head—Great Lakes 659, Premier Great Lakes, Fulton, Mesa 659

Muskmelon (Cantaloupe)
Burpee Hybrid, Gold Star, Saticoy Hybrid, Iroquois, Delicious 51, Harvest Queen, Harper Hybrid

Mustard
Tendergreen*, Southern Giant Curled, Green Wave

Okra
Emerald, Dwarf Green Long Pod, Clemson Spineless

Onion
green (bunching)—White Portugal, Beltsville Bunching, Ebenezer, Yellow Globe strains
dry (storage)—Ebenezer, Yellow Globe strains, Elite, Buccaneer
sweet (use plants only)—White or Yellow Sweet Spanish, Bermuda

Parsley
Perfection, Extra Curled Dwarf

Parsnip
Hollow Crown*, Harris' Model, All-America

Peas
Shelling—Little Marvel, Thomas Laxton*, Wando*, Freezonian*, Frosty*, Alderman* (tall growing)
edible pod—Dwarf Gray Sugar

Pepper
green (mild)—California Wonder, Yolo Wonder strains, Calwonder, Keystone Resistant Giant, Midway, Staddon Select, Canape, Bell Boy Hybrid
yellow (mild)—Golden Calwonder
banana type—Sweet Banana
hot type—Hungarian Wax, Long Red Cayenne, Large Red Cherry
pimento—Sunnybrook, Early Pimento
sweet cherry type—Sweet Cherry

Potatoes
early—Irish Cobbler, Norland (red)
midseason—Chippewa, Superior
late—Katahadin, Sebago, Kennebec, Red Pontiac

Pumpkin
Small Sugar, Connecticut Field, Young's Beauty, Howden's Field

Radish
spring—Early Scarlet Globe, White Icicle, Red Prince, Scarlet Knight, Champion
winter—Round Black Spanish

Rhubarb
McDonald*, Victoria*, Canada Red*, Valentine

Rutabaga
American Purple Top (Long Island Improved)

Salsify
Mammoth Sandwich Island

Soybeans (edible)
Kanrich

Spinach
Long Standing Bloomsdale, America, Viking*, Hybrid No. 7, Winter Bloomsdale

Squash
summer—White Bush Scallop, Summer Straightneck, Zucchini, Cocozelle
fall and winter—Table Queen, Buttercup, Waltham Butternut, Delicious*, Golden Hubbard*, Green Hubbard, Big Max, Gold Nugget

Sweet Potato
dry flesh—Yellow Jersey, Little Stem Jersey, Triumph
moist flesh—Centennial, Nemagold, Nancy Hall*, Puerto Rico*

D—Determinate vine type ([illegible] topping, bushy and non-vining) which means they should not be pruned
V—Verticillum Wilt Resistant
F—Fusarium Wilt Resistant
N—Nematode Resistant

Tomatoes
early—Fantastic, Moreton Hybrid (V), Campbell 1327 (D) (VF), Jetstar (VF)
midseason—Marglobe (F), Heinz 1439 (D) (VF), Heinz 1350 (D) (VF), Big Boy Hybrid, Better Boy (VFN), Burpee VF (VF), Roma VF (D) (VF), Campbell 28 (F) (D)
late—Rutgers (F), Heinz 1370 (D) (F), Supersonic (VF), Ramapo (VF)
yellow—Golden Jubilee, Sunray (F)
pink—Pinkshipper (F)
suitable for cage culture—Jet Star (VF), Fantastic, Burpee VF (VF), Heinz 1350 (D) (VF), Campbell 28 (F) (D), Setmore (VF) (D)

Medium to small fruited
large vine with small fruit—Small Red Cherry, Large Red Cherry, Red Pear, Yellow Pear, Small Fry
dwarf vine with medium fruit—Patio Hybrid and Pixie Hybrid
dwarf vine with small fruit—Tiny Tim

Turnip
Purple Top White Globe, Just Right Hybrid (fall use), Tokyo Cross, Tokyo Market

Turnip Greens
Shogoin, Seven Top*

Watermelon
Sugar Baby, New Hampshire Midget, Early Kansas, Kleckley's Sweet, Seedless Hybrid 317, Crimson Sweet, Summer Festival, Royal Charleston

The appearance of "Midget," also called "Mini" and "Dwarf," vegetable varieties on the market has prompted many questions about these vegetables. Due to their relatively recent appearance on the market, adequate research on their adaptability to Ohio conditions has not been conducted. Therefore, listed below are several of these variety names for your convenience. Experience, research and reports will provide additional information for making variety suggestions in the future.

Midget Vegetables

1. **Bean**—Dwarf Horticultural Bush Shell
2. **Cabbage**—Dwarf Morden, Little Leaguer and Baby Head
3. **Cantaloupe**—Minnesota Midget
4. **Carrots**—Tiny Sweet, Short'n'Sweet and Little Finger
5. **Cucumber**—Cherokee, Little Minnie, Patio-pik and Tiny Dill (New Hamp.)
6. **Eggplant**—Morden Midget
7. **Lettuce**—Tom Thumb (head lettuce butterhead type) and Butter Crunch
8. **Peas**—Mighty Midget
9. **Squash**—Gold Nugget
10. **Sweet Corn**—Golden Midget, Midget Hybrid and White Midget
11. **Tomatoes**—Patio Hybrid, Tiny Tim and Small Fry
12. **Watermelon**—Lollipop—Yellow and Red, Little Midget and Golden Midget

Source of Seed—Garden supply stores and seed firms supply many different kinds of seed. It is usually better to buy seed rather than to save your own. Some diseases can be transmitted on or in improperly processed seed. Seed of a certain variety or hybrid may be available from only one supplier. Since varieties can now be patented, it may become increasingly more difficult to obtain seed of a particular variety from more than one source. If you are unable to secure your seed locally, and your supplier cannot suggest a suitable substitute, write to the **Department of Horticulture, The Ohio State University, 2001 Fyffe Court, Columbus, Ohio 43210.** Ask for the latest information on firms supplying the particular variety in which you are interested. The Department of Horticulture does not distribute seeds or plants.

Ohio Extension Bulletin 287, Home Vegetable Gardening, contains information about soil management, cultural practices for specific vegetables, and other aspects of gardening. This bulletin, as well as information on other horticultural and agricultural practices, is available at your county Extension office.

The Ohio Cooperative Extension Service extends the educational programs of The Ohio State University to all corners of the state.

With offices in every county and 10 area centers, it offers the citizens of Ohio programs designed to help them improve their levels of living. Programs relate especially to the agricultural industry, family living, 4-H and other youth, and community and natural resource needs.

In Ohio, Extension is backed by the total resources of The Ohio State University College of Agriculture and Home Economics, the Ohio Agricultural Research and Development Center, and the United States Department of Agriculture. Its services—one of which is providing you with this publication—are financed jointly by county, state, and federal governments. Program efforts are carried out through meetings, workshops, tours, in-depth schools, and communications media.

Extension is directed by state and federal laws to assist adults and youth in both rural and urban areas and without discrimination as to race, color, or national origin.

1/75—20M

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Roy M. Kottman, Director of the Cooperative Extension Service, The Ohio State University.

The information contained in this publication is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Cooperative Extension Service is implied.

January, 1975

Bulletin 498

HOME VEGETABLE GARDEN INSECT CONTROL

654

Cooperative Extension Service / The Ohio State University

IMPORTANT

"An amendment to the Federal Insecticide and Rodenticide Act was passed by Congress and signed by the President on October 21, 1972. This regulation classifies all pesticides for general or restricted use. It requires anyone who applies for restricted pesticide to be certified. The new regulation makes it a criminal offense to misuse a pesticide. You should remain aware of these changes and be alert to any specific requirements which affect your operation."

DISCLAIMER CLAUSE

The information given herein is supplied with the understanding that no discrimination is intended and no endorsement by the Cooperative Extension Service is implied. The authors have assembled the most reliable information available to them at time of publication. Due to constantly changing laws and regulations, the Ohio Cooperative Extension Service can assume no liability for the recommendations.

Prepared by

The Vegetable Insect Control
Recommendations Committee

For additional information,

Contact Richard L. Miller, Extension Entomologist,
The Ohio State University, 1735 Neil Avenue,
Columbus, Ohio 43210.

Do not use this bulletin after the 1975 season. Obtain a new bulletin each year for up-to-date registered uses of pesticides.

Contents

Insects and their control 2
Understand insecticides before using them .. 4
Light traps 7
Soil insects 7
Insecticide equipment 7
Slugs 8
Pictures of Common Vegetable Pests 9
Insect and mite control recommendations .. 10
Ohio Poison Information Centers 16

"All educational programs and activities conducted by the Ohio Cooperative Extension Service are available to all potential clientele on a nondiscriminatory basis without regard to race, color, or national origin."

1/75—30M

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U. S. Department of Agriculture. Roy M. Kottman, Director of the Cooperative Extension Service, The Ohio State University.

Home-grown vegetables not only help reduce the food bill but also provide a person with many of the essential vitamins and nutrients found in abundance in vegetables. To raise vegetables today without having them attacked by a wide range of insects is almost impossible. So, if you are planning a garden you'll need some sort of pest control program. This bulletin presents important facts to the home gardener about insects and insecticides that will help him control, safely and effectively, the more troublesome pests. Use of this information will aid the home gardener in getting the most from his pest control program.

INSECTS AND THEIR CONTROL

There are probably 30 or more different kinds of injurious vegetable garden pests. We can never tell which ones will be a problem from one season to the next or just how severe each will be. Some insects are a problem nearly every year, like bean beetles; others present a problem only once in a while. The exact time an insect will appear in the garden varies with the different insects and the weather. Some insects spend the winter in or close to the garden and as soon as the temperatures warm up to 40° F. or above, these insects become active. Other insects may fly to or from the garden at random. Still others come to the garden later in the summer. We will have insects from the time the garden is planted in the spring until it is destroyed by frost in the fall. Let's discuss these insects and their control.

Importance of Identification

Most people do not know one bug from another and consider all of them harmful. If a vegetable leaf has a piece eaten out of it and a bug is on the plant, they assume this insect caused the damage. Such guilt by association is very often incorrect. Not all insects are destructive nor do they all have chewing mouthparts. Unless you know your insects, you cannot be sure that the one you see is destructive. More than one beneficial insect has been sprayed because it was thought to be destructive, while the destructive one was allowed to live.

Most insects have three or four stages in their development and may be destructive in only one or two of these stages. Moths and butterflies, for example, are harmless as adults but very destructive in the worm stage. Some beetles, like the Japanese beetle, are destructive in the larval as well as the adult stages. If you don't know your insects, you may control the wrong stage and get discouraged because you're not able to stop injury to your plants. By knowing the correct identification of an insect we may learn if it is a good one or a bad one, if it has chewing or sucking mouthparts, the number of generations it has in a season, which stage or stages are destructive, its favorite food, and where it lives. We can then determine how, when, and where the insect can best be controlled.

Where To Get Help

If you need help in getting your insects identified and/or information about which insecticide to use, the Ohio Cooperative Extension Service, a part of The Ohio State University, has a county Extension office in each of Ohio's 88 counties. In these offices are personnel like the County Extension Agent, Agriculture, who can help you with your insect problems. You may also get help from the Extension Entomology office, The Ohio State University, 1735 Neil Avenue, Columbus, Ohio 43210. If you send your insects in to be identified, put them in crush-proof boxes. Also, tell as much about the situation as you can. This service is provided free of charge. Learning to identify an insect and getting a correct insecticide recommendation is 50 per cent of insect control; the other 50 per cent depends upon you and how good a job you do.

What Is Behind an Insecticide Recommendation

Once you have identified your insect problem, find out what insecticide to buy and how to use it. One of the major reasons home gardeners are often dissatisfied with an insecticide and the results they get is because they will buy one and use it as *they think* it should be used. If you do not use an insecticide correctly, you may expect poor results, even though the insecticide may be correct, the best, and the most expensive. Let's see, in the following typical example, what goes into making an insecticide recommendation:

> *Mix 2 teaspoonfuls of malathion — 57 per cent liquid concentrate — in 1 gallon of water and spray the foliage thoroughly until it is wet. Repeat at 10-day intervals or as needed but not closer than 3 days before harvest.*

Here's how researchers arrive at data used in recommendations. Insecticide recommendations are based upon tests and trials conducted by research entomologists. Let's say that we are interested in the control of bean beetles and leafhoppers on green beans. A researcher will plant many rows of beans in a test field and let them become naturally infested with bean beetles and leafhoppers. Then the insecticides that he is interested in testing are selected along with the different rates that he wants to test. The different rates are important because he is interested in finding out the lowest amount of each insecticide that will control the insects effectively and not cause injury to the beans.

The next step is to spray the bean plots with the various insecticides at the various rates. Some rows receive no treatment. These are "check plots" and are used by the researcher to compare results of treated rows. Now he must determine which of the insecticides and what rates most economically kill the insects. To do this he either counts the live insects present on the plants or uses some other means which will give him an accurate measurement of how effective the insecticides are.

He is also interested in knowing just how long the insecticide continues to be an effective killer of the insects. To learn this, he may record his insect counts at 7-day intervals until there are just as many insects in the treated plots as there are in the untreated ones. This tells him that the insecticide is no longer strong enough to kill the insects. In addition, some of the beans are collected and analyzed for insecticide residues to determine how close to harvest the insecticides may be applied without leaving illegal residues on the beans. After all these data have been collected from the field and laboratory, the information is fed into a computer and analyzed statistically. Part of the statistical results are transformed into an accurate and unbiased insecticide recommendation like the one mentioned earlier.

To get the most from your insecticides, follow the recommendations closely. Once you know what to use, the next important thing is to apply the insecticide thoroughly, at the recommended dosage, and at the proper time. Let's review the importance of these two points.

Importance of Correct Timing and Thorough Application

Most people who raise a garden wait until they have a severe insect infestation before they apply control measures. Very often this is too late because severe plant injury has already resulted. To prevent excessive injury to garden plants, the gardener must make frequent inspections of the entire garden at least once a week to observe the presence and severity of insect infestation. At the first sign of an infestation, control measures should be applied and repeated as often as necessary to keep the insects at a low level. Home gardeners can avoid insect injury if they spray their gardens every 7 to 14 days throughout the growing season.

Another point that must be stressed is the importance of thorough application. What we are striving to do here is place a thin layer of insecticide over the exposed surfaces of the plants so that no matter where an insect may eat or walk on the plant, it will be exposed to a lethal amount of insecticide. Unless the insecticide is applied thoroughly to the plant, an insect could escape coming in contact with it and thereby not be killed.

Inspect plants regularly to become aware of pest build-up.

Control aphids and mites before they become numerous.

Spray when the wind is less than 5 mph. Dust only when the wind is calm.

Do not treat plants during the hottest part of the day or when they are wilted.

Rain washes pesticide from plants which means retreating may be necessary.

Apply treatment to all plant surfaces. Treat only when necessary to prevent or control insect injury. Apply only recommended dosage. More will not improve control—it is dangerous, may cause plant damage and leave harmful residue on produce.

Mix only what pesticide is needed for immediate use—many insecticides lose their effectiveness if left in water overnight.

Days-Waiting-Time — Treatment to Harvest

Most insecticides may be applied to the edible portions of vegetables. However, before the treated vegetables are harvested, days-waiting-time between treatment and harvest must be observed. Before an insecticide can be sold for use on vegetables, research data must show how long it will last on a crop. The information gained here becomes part of the restrictions that must be printed on the insecticide label. These restrictions are expressed as the number of days from the last application of the insecticide until the vegetable can be harvested. The number of days that you must wait before harvesting varies depending upon the insecticide and the crop; therefore, you must look on the insecticide label for this information. If you observe the days-waiting-time, there should be no reason to fear that your vegetables will have harmful residues of insecticide on them at harvest time. Remember the information on the insecticide label is based on very thorough and expensive research.

UNDERSTAND INSECTICIDES BEFORE USING THEM

Most people have very little knowledge about insecticides and don't realize the potential danger they present to the user, especially if used carelessly or incorrectly. Before you use an insecticide, you owe it to yourself and to those around you to learn some facts about these potentially dangerous poisons. Following are facts which will help you to better understand and appreciate insecticides.

The Insecticide Label

Read and follow instructions on the insecticide label and you can obtain results as good as any professional. The insecticide label is very explicit in stating how the product should or should not be used to get the best results and yet be safe to the user and the crop on which it is applied. You should always read the parts of the label that give directions for use and the precautions to be followed. It's your guide to safe and effective insect control.

How Insecticides Kill

Some insecticides, like lead arsenate, are called stomach poisons. These poisons kill insects only if eaten by them. Other insecticides such as malathion will kill insects if they eat the poison, walk on a treated surface, or if they are sprayed directly by the insecticide. These insecticides are called "contact-residual insecticides." Many of the modern insecticides kill by more than one method.

How Long Insecticides Last

Insecticides like chlordane are considered long-lasting and can kill insects for several weeks or even several years as in the case of soil treatment for wireworms. Materials like pyrethrin, a common ingredient in aerosol sprays, may last less than one hour. In general, an insecticide that is classified as a chlorinated hydrocarbon is long-lasting. Examples of these insecticides are aldrin, dieldrin, chlordane, and lindane. Insecticides belonging to the organic phosphate class are considered shorter-lasting. Examples are malathion, Diazinon, parathion, and naled. However, just how long an insecticide will last depends on how and where it is used. In the garden, most insecticides that we can use do not last more than one day to two weeks.

Rain, Temperature, and Light Affect Insecticides

Insecticides sprayed on plants will not kill insects indefinitely because such things as temperature, humidity, wind, and sunlight affect the length of life of the insecticide. The greater the extremes of these factors, the quicker the insecticides become less toxic. That is why we must constantly repeat spray applications. Rain, to some degree, removes all insecticides from plant foliage.

In general, an insecticide is less likely to be washed off if it has had an opportunity to dry thoroughly on the foliage before a rain. Most insecticides should be reapplied the day after a heavy rain. Strong sunlight and driving winds cause insecticides to become less effective.

Storage Life of Insecticides

Insecticides can be used from one year to the next. However, it would be better if a gardener bought only what he could use in one season. Moisture, air, light, and temperature are factors which when in contact with a dust, wettable powder, liquid concentrate, or granules will degrade them. The chlorinated hydrocarbons keep longer than the phosphate insecticides. Store all insecticides in a dry place where the temperature will not go below freezing or above 100° F. Pesticides should always be stored in the original container only. The storage area should be clearly marked "Poison Storage" and locked when not in use. Replace caps or lids tightly on all containers. Packaged materials should also be properly labeled and tightly closed to keep out moisture. These suggestions, if followed, should help you keep your insecticides longer. However, it is still better not to buy more insecticides than you can use in one growing season.

How Insecticides Are Sold

Insecticides may be purchased in forms such as dusts, wettable powders, liquid concentrates, granules, oil solutions, and aerosol formulations. Let's discuss the good and bad points of each of these formulations.

Dusts are made of finely divided talc or clay particles which have an insecticide mixed with them. Dusts are sold in strengths of one-half to 10 percent. They are easy to apply and usually will not cause injury to the more tender plants if used at the recommended rates. In general, dusts are less desirable than sprays because they are easily blown away during application and are more difficult to handle and apply. Larger amounts are required to treat a garden because of the low percentage of active ingredient. Rains wash them from plants rather easily, too. Dusts adhere to foliage much better if applied when plants are wet with dew.

Liquid concentrates are a high concentration of the "pure" insecticide dissolved in an oil type solvent. Other materials are added to the concentrate to make the insecticide mix with water. Liquid concentrates are sold in strengths of about 18 to 75 percent. Since they are concentrates, it takes only a small amount mixed in water to make an effective spray. A disadvantage of liquid concentrates is that they may cause plant injury under certain weather conditions because of the oil base solvents they contain. However, for the most part, the concentrates are the best formulation for the home gardner.

Wettable powders are similar to dusts. The main difference is the added ingredients which permit powders to be mixed with water. Wettable powders are sold in strengths from 15 to 80 percent. Since they are not formulated with oil base solvents, they are preferred over liquid concentrates for use on plants which may be injured by oil. One of the major disadvantages of wettable powders is that the powders will settle to the bottom and plug up the nozzles unless they are kept agitated in the sprayer.

Granules are similar to dusts except they are impregnated with the insecticide and are of much larger particles. Granules are sold in strengths from 1 to 20 percent. They are used mainly for application to lawns or as soil insecticides. You do not mix granules with water but apply them as purchased with a special piece of equipment called a granular applicator.

Oil solutions contain insecticide mixed in a highly refined oil and are used primarily for the control of household pests like cockroaches or wood borers. These formulations are sold in strengths from ½ to 5 percent in low pressure, atomizer type containers. Oil solutions should never be used on plants because the oil will kill living tissue.

Aesorol sprays usually contain a mixture of several insecticides in a pressurized can. For the most part, they contain only a small percentage of insecticide and are designed for small jobs. Until recently, aerosol sprays were used mainly for killing flying pests in the house. Today, many of the aerosols can be applied to rose bushes or other outdoor plants. They are not practical for general vegetable garden use because they are too expensive and do not contain enough insecticide.

All-Purpose Insecticide Mixtures

Many different insecticides are recommended in this bulletin since certain ones do a more effective job of controlling specific insects. The home gardener is not expected to buy all these insecticides unless he wants to use the best material against specific pests. Many people garden for the enjoyment. They do not want to be bothered with having to buy and apply 10 or more different insecticides. For these people, we have what is called an all-purpose mixture. The main selling point of such mixtures is that the user need buy only the one bottle or package and use it to control all of his yard and garden pests.

For the most part, the mixtures do a good job of pest control. Most all-purpose sprays are of the wettable powder type and contain malathion, methoxychlor, and the fungicide captan. Malathion is added primarily for control of the sucking insects and mites; methoxychlor for the chewing ones. Both of these insecticides are among the safest we have.

One of the major disadvantages of these two insecticides is that they are not satisfactory against some of the more troublesome garden pests. Also, because of their short residual nature, they must be applied at weekly intervals. There are some liquid all-purpose sprays, too, and these are the ones with which we must be particularly careful. These sprays often contain combinations of long-lasting materials.

If you buy one of the all-purpose mixtures, make sure you read the label carefully to learn what the mixture can and cannot be used on and some of the other important instructions, suggestions, and precautions.

Sprays or Dusts

Both sprays and dusts will control insects if applied in the proper concentration and at the proper time. In general, sprays are better than dusts. Dusts do not stick to the plants easily unless the plants are moist; rains wash them off more easily. Because they are so light in weight, dusts blow away and may create problems by contaminating nearby areas.

Insecticide-Fertilizer Mixtures

Today we can buy insecticides impregnated fertilizers. These mixtures are made for soil insect control and are intended to get two jobs done with one application — that is, fertilize the plants and control the insects. The idea is good but there are some serious drawbacks to these mixtures. Let's discuss some of the problems associated with them.

1. For a soil insecticide to be effective, it must be mixed thoroughly in the top three to five inches of soil. We often want our fertilizer deeper in the soil. Soil insecticides are not water soluble. Therefore, they are not moved easily in the soil. Since the placement of fertilizer and insecticide is not always wanted in the same place and at the same time, we sacrifice the efficiency of one material for the sake of getting two jobs done at one time.

2. Fertilizer is usually needed every year, but this is not true with soil insecticides. One application of insecticide should control soil insects for nearly three seasons. A yearly application could result in a highly contaminated soil which might injure plants grown in it. Once a soil becomes highly contaminated, nothing can be done to remove the insecticide except time itself.

3. We should never handle fertilizer containing an insecticide with our bare hands because the insecticide will be absorbed into our bodies. Also with a hand application, we are likely to apply far more insecticide than is recommended.

4. Perhaps one of the most important disadvantages of a fertilizer-insecticide mixture is that not all vegetables are approved to be grown in soil treated with a particular insecticide because of harmful residues.

In general, we must say that insecticide-fertilizer mixtures have too many disadvantages to be recommended for use in the home garden.

How Poisonous Are Insecticides?

All insecticides are poisonous. However, some are much more toxic than others. The insecticide label usually states in the **precaution section** how toxic the insecticide is. For example, a skull and crossbones will always be found on the label of highly toxic materials. Those of medium toxicity carry less severe warning statements. The toxicity of an insecticide is expressed by the terms oral and dermal LD_{50}.

LD_{50} means the lethal dosage of poison required to kill 50 percent of the test animals (usually rats or rabbits) with a single application of the pure insecticide for a given weight of animal (milligrams per kilograms of body weight mg/kg). The lower the LD_{50} value, the more toxic the material.

Oral LD_{50} is a measure of toxicity of the insecticide when administered internally to the test animals.

Dermal LD_{50} is a measure of toxicity when the "pure" insecticide is applied to the skin of the test animals. Generally, the oral application is more toxic than the dermal.

We must be careful how we interpret the LD_{50} value of a pesticide. Keep these facts in mind: (1) Hazards presented by any compound depend on how it is used rather than on how toxic it is. (2) Toxicity may vary with species, age, sex, nutritional state, and formulation of poison as well as with the route of administration. Since LD_{50} values are given for animals, they can be applied only with reservation to man. (3) An LD_{50} value is a statistic which in itself gives no information about the dosage that will be fatal to a very small proportion of a large group of animals. (4) LD_{50} values are usually expressed in terms of single dosages only. Thus, these values give little or no information about the possible cumulative effects of a compound.

In spite of its shortcomings, the LD_{50} value is at least a general measure of the relative toxicity of a compound. Many publications are available which list the LD_{50} values of major pesticides. If you want to know the relative toxicity of an insecticide to test animals, ask your county Extension agent, agriculture, or write to the Department of Entomology, The Ohio State University, 1735 Neil Avenue, Columbus, Ohio 43210.

Table 1 lists a group of the more commonly used insecticides and their oral and dermal LD_{50} values. Remember, the lower the LD_{50} value, the more toxic the pesticide. Any material with an LD_{50} value of less than 100 is considered highly toxic and should be handled carefully. Some insecticide labels state that the chemicals should be used by trained or professional applicators only and therefore that **such materials should never be used by the home grower.**

Table 1. Dermal and Oral LD_{50} Values[1] on Laboratory Animals for Some of the more Common Insecticides and Miticides

Insecticide	Oral (mg/kg)[2]	Dermal (mg/kg)[2]
	Chlorinated Hydrocarbons[3]	
Aldrin	39	98
BHC	1250	—
Chlordane	335	840
Dieldrin	46	90
EPN	36	230
Heptachlor	100	195
Kelthane	1100	1230
Lindane	88	1000
Methoxychlor	5000	6000
TDE	4000	4000
Thiodan	110	359
Toxaphene	90	1075
	Organic Phosphates[3]	
Cygon, De-Fend[4]	215	400
Dasanit	11	30
Diazinon	466	900
Dibrom	430	1100
Di-Syston[4]	7	15
Ethion	70	915
Guthion	13	220
Malathion	1375	4444
Metasystox-R[4]	65	250
Parathion	13	21
Phosdrin[4]	6	5
Phosphamidon[4]	24	143
Systox[4]	6	14
TEPP	1	2
Thimet[4]	2	6
Trithion	32	1270
V-C 13	250	—
	Carbamate[3]	
Sevin	850	4000
	Carbonate[3]	
Morestan	1800	2000
	Plant Extract[3]	
Rotenone	75	940
	Sulfone[3]	
Tedion	14,700	10,000

[1] Source of information: USDA Handbook No. 331, May, 1968

[2] Equals milligrams per kilogram of body weight applied orally or dermally. (1 milligram = 1/1000 of a gram, 454 grams = 1 lb.)

[3] Class to which the insecticide belongs

[4] Systemic insecticides

What Are Systemic Insecticides?

Systemics are a specialty group of insecticides. They are sprayed on plants or applied to the soil in which plants are grown. The insecticide is absorbed into the leaves or roots and carried throughout the entire plant in the sap stream. Smaller insects like aphids, leafhoppers, or flea beetles are killed by merely feeding on the plants. The killing power of systemic insecticides may last for two or three months on some plants. Systemics cannot be used on all plants. Their use on some plants results in excessive residues appearing in the edible parts of the plants at harvest time. Systemic insecticides are very toxic and should be used with the utmost care. See Table 1 for an idea of their toxicity. Be sure to follow the label restrictions and suggestions right to the letter. Be especially careful not to get any of the insecticide on your skin. Also, store the materials in a safe place away from children and pets; preferably under "lock and key."

LIGHT TRAPS

Light traps will not rid your garden of all destructive insects. First of all, insects are attracted to the radiant energy that is emitted by certain types of lights. The ordinary light bulb is very attractive to a wide variety of flying insects. Some lights, like the "Black Light," emit their radiant energy in a much narrower range than the light bulb and are highly attractive to many insects. Researchers have, for a long time, used light traps to determine the presence and number of different species of insects in an area. As a survey tool, they have aided entomologists tremendously. We must understand that beneficial insects are attracted to the lights, too. Many insects are drawn into the area of the light that normally would not be there. Also, we must realize that only night flying insects can be captured by the traps. Wingless insects and insects like the housefly, which flies only in the daytime, can't be caught. So we must say that light traps will not keep a garden or yard free of insects and therefore are not recommended for use in this bulletin.

SOIL INSECTS

There are several insects such as cutworms, wireworms, white grubs, and flea beetle larvae which live in the soil in the larval (worm) stage and feed on the roots or underground edible parts of our vegetable crops. These pests cause unestimable damage. We are more concerned about these soil pests when growing vegetables, like potatoes, carrots, turnips, and radishes, that have the edible parts underground. In general, we can expect to get injury from soil pests if we plant a garden in an area that has been in sod for two or more years or planted to the same crops repeatedly. When we plow up these areas we destroy the insects' food supply. To keep from starving, the insects will attack any vegetables we plant. Also, other insects will be attracted to the garden and lay their eggs in the soil. The developing larvae will become pests. We have soil insecticides that can control all of our soil pests but not all of these can be used on our vegetable crops.

Recommended Soil Insecticides

Before a soil insecticide can be approved for use in soil planted to vegetables, it must be studied by research entomologists and shown not to remain on the vegetables in harmful quantities at the time of harvest. With some insecticides and on some crops, we are permitted a trace amount of insecticide on the crop at harvest time. One phase of the insecticide study is the feeding of the insecticide to test animals in varying amounts over a long period of time to determine the effect, if any, the insecticide has on the test animals. If the research shows there are no harmful effects from trace amounts of the insecticide, the crop is then permitted to be planted in the treated soil. Because of the wide variety of crops we plant in the home garden and the varying nature of our soil insecticides, we are very limited in the soil insecticides that can be used safely in the garden. Chlordane and Diazinon are about the only ones that can be used (See Table 2)

How and When To Apply

For a soil insecticide to be effective, it must be applied to plowed ground and worked thoroughly into the top three to five inches of soil. It should be placed in the soil any time after the ground has been plowed, preferably during March, but before the garden is planted. This point is important because the insecticide will have an opportunity to distribute itself evenly throughout the soil and kill insects as they move around in the soil in search of food but before garden crops start to grow. The insecticide may be applied as a liquid concentrate, wettable powder, or as granules. Dusts are not recommended. The important thing to remember is that the insecticide must be applied to plowed ground, evenly over the entire area to be treated, and worked immediately into the top three to five inches of soil. Two insecticides and the rates at which they should be applied in the garden are shown in Table 2.

Table 2. Garden Soil Insecticides and Rates

Insecticide	Formulation You Buy	Amount to Apply to Each 1,000 Sq. Ft. of Garden Area
Chlordane	45% EC*	8 tbsp.
	75% EC	4 tbsp.
	40% WP**	12 tbsp.
Diazinon***	25% EC	12 tbsp.
	50% WP	6 tbsp.

* emulsifiable concentrate

** wettable powder

*** The 25% EC is sold as Spectracide.

Note: Carrots and pumpkins should not be planted in chlordane-treated soil. Do not apply Diazinon to soil to be planted to eggplant, pumpkins, or rutabaga.

INSECTICIDE EQUIPMENT

Much of the success or failure you have with your insect control program can probably be traced to the kind of equipment you used to apply the insecticides. Most homeowners have only a small garden area and cannot afford or justify buying power equipment like commercial growers use. Following are some of the types of equipment that are acceptable for use by the home gardener.

Hose-end sprayers are small sprayers you screw onto the end of an ordinary garden hose. The spray container varies in size from one-half pint to one quart and will deliver from 1 to 15 gallons of spray when the contents of the container are emptied. The insecticide is added on the basis of recommended amounts per gallon of spray. The sprayers are put in operation by turning on the water and placing the thumb over a small hole in the top of the lid. The insecticide is drawn from the container and mixed with the hose water as it is propelled out the nozzle. One of the major disadvantages of this type sprayer is that wettable powder often plugs up the nozzle. A big advantage of the hose-end sprayer is constant pressure. You need no pumping to maintain pressure as in compressed air tanks.

Compressed air sprayers are metal tanks which vary in size from one to three gallons. Air is pumped into them with the aid of a plunger equipped with the tank. The spray is delivered through an attached hose with a hand shut-off valve and a nozzle tip. Disadvantages of this type sprayer are: It must be pumped up frequently to maintain pressure, you have to carry the tank around as you go, the nozzle tips are of the low volume type and a relatively long time is required to empty the tank, and tanks will rust out in a few seasons. In spite of these disadvantages, the compressed air sprayers are highly recommended.

Knap-Sac Sprayers are compressed air sprayers which vary in size from three to five gallons and are strapped onto one's back. A handle pump is attached and is pumped continuously at a slow pace. The pumping builds up a pressure in the tank and allows the spray to be delivered through a hose and nozzle tip at an even, steady rate. It, too, is equipped with a hand shut-off valve. This type of sprayer is designed for use in gardens up to one acre or more in size. Disadvantages are: the sprayers are expensive, loaded with water they're quite heavy, and you still have to pump them. However, a stainless steel knap-sac sprayer should last many years and handle any spray job in the garden and around the home except tree spraying.

There are other types of application equipment such as bucket pumps, trombone sprayers, hand dusters, and others but the ones discussed above are probably more acceptable for yard and garden spraying.

Things you should keep in mind before buying a piece of spray equipment are the size of the job to be done, kind of performance you desire, kinds and amounts of insecticides you'll be using, amount of water needed per spraying, the size of the plants to be treated, and amount of money you want to spend. If you have these facts in mind when you go to your spray equipment dealer, he'll be able to sell you the correct piece of equipment for you and your job. Remember that a piece of equipment is no better than what you pay for it, no better than the man who uses it, and all equipment must be serviced and cleaned frequently.

Accessory Equipment: There are two extra pieces of equipment which the home gardener should have. These are (1) a one-quart measuring cup and (2) a set of measuring spoons. This equipment should be kept separate from that which is used in the home. It should be marked in some way to indicate that it is for pesticide measurements only and should be stored with the pesticides. Measuring equipment is necessary to measure accurately the required amounts of insecticides, thus ensuring better pest control results and less plant injury.

Rhubarb curculio

The adult rhubarb curculio is one of the largest snout beetles and measures about $\frac{1}{2}$ inch in length. Newly emerged beetles are covered with a rusty powder and appear reddish in color. However, older beetles are nearly black. The adult female beetle bores into stalks of rhubarb with its chewing mouthparts and then lays eggs in the punctures. Injury to rhubarb is merely the result of the punctures and the small amount of feeding by the adults on rhubarb foliage. Larvae develop in common curled dock and most adult feeding occurs on that plant. The rhubarb curculio is not considered a serious pest. The elimination of dock from the vicinity of rhubarb should help to reduce the occurrence of this insect in rhubarb.

SLUGS

The past couple of years have seen an increase in the number of cases of reported slug injury. This increase in slug population is undoubtedly the result of favorable environmental conditions for slug reproduction and survival. Young seedlings and the more succulent parts of plants and even some entire plants are devoured by these pests. They leave a trail of mucus on the surfaces on which they crawl, and, on drying, silvery marks result. It seems that moist, humid environments favor slug development. Slugs generally spend the winter in sheltered situations outdoors. Eggs are usually deposited in moist habitats and maturity requires a year or more.

Many different modern-day insecticides have been tested against slugs and very few show any promise at all. The following are suggestions for minimizing slug damage to either vegetable or flower gardens:

1. Spade or rototill the garden area in the fall.
2. Spade or rototill the garden again around April 1.

3. Maintain a system of clean cultivation by hoeing so that the surface of the soil is dry and crumbly. This is a very important factor in reducing slug damage.

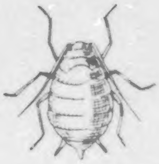
4. Where heavy infestation of slugs cause serious damage, hand-picking will reduce slug populations. Use a flashlight to check infestation. About 10:00 p.m., inspect garden for active slugs. Those detected can be picked up with an old teaspoon. Place captured slugs in a container of salt which will kill them. If this activity is continued for 3 or 4 nights in a row, damage can be greatly reduced.

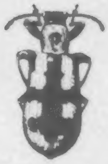
5. In order to increase organic material in the soil, it is best to compost materials such as grass clippings, leaves, and other plant debris for at least one year. At the end of this time the compost should be black and crumbly. This then should be spread over the garden and spaded into the soil.

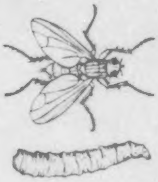
6. Gardeners have reported some success with beer placed in small cups or pans sunken in the soil so the lip of the containers is slightly below the level of the ground. Slugs are attracted to the containers; once inside they drown. The beer needs to be replaced about every three days for best results. However, stale beer may be used. Slug populations can be greatly reduced if this method is started early in the spring and enough of the containers are set out.

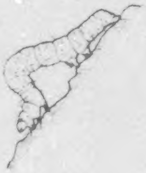
7. Slug baits are available and effective against this pest if applied exactly as directed on the label.

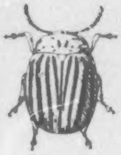
SOME COMMON VEGETABLE PESTS

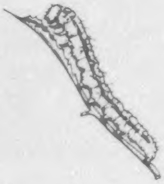

Aphid or plant louse

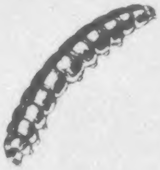

Asparagus beetle

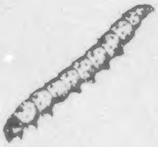

Cabbage maggot

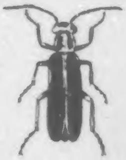

Cabbage looper "inchworm"

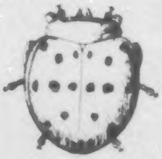

Colorado potato beetle or potato bug

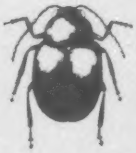

Corn earworm

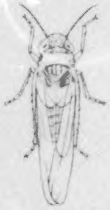

Cutworm

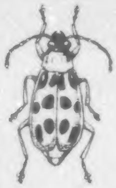

European corn borer

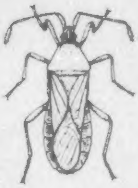

Margined blister beetle

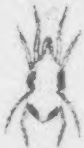

Mexican bean beetle

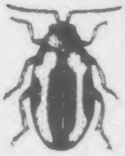

Potato flea beetle

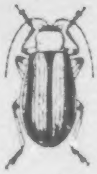

Potato leafhopper

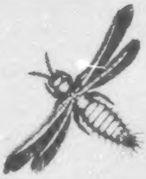

Spotted cucumber beetle

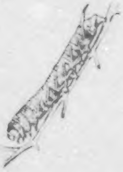

Squash bug

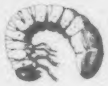

Spider mite

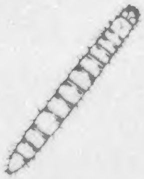

Striped cabbage flea beetle


Striped cucumber beetle


Thrips


Tomato hornworm


White grub


Wireworm

TABLES OF MEASURES

The following tables of measures are useful in preparing small quantities of insecticide for garden application.

Liquid measures:

3 teaspoons = 1 tablespoon
2 tablespoons = 1 fluid ounce
8 fluid ounces = 1 cup
2 cups = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon

Approximate quantities of powder required to weigh 1 ounce:

Carbaryl wettable powder	6 level tablespoons
Chlordane wettable powder	5 level tablespoons
Kelthane wettable powder	5 level tablespoons
Malathion wettable powder	4 level tablespoons
Methoxychlor wettable powder	4 level tablespoons

SPECIAL NOTE

There is a possibility that you may not be able to buy some of the insecticides that are suggested in this bulletin because of a shortage of supply. If you have a newly purchased material and the label directions differ from those in this bulletin, follow your label.

INSECT AND MITE CONTROL RECOMMENDATIONS

Crop	Pest	Recommended Pesticide	Formulation You Buy	Amount to Add to Make One Gallon of Spray	Days-Waiting-Time From Last Application Until Harvest	When to Treat
Asparagus	Asparagus beetle	Sevin	50% WP*	3 tbsp.	1	Treat spurs and vine growth as soon as beetles appear and repeat as needed.
			25% Liq.**	2 tbsp.	1	
		Malathion	50% EC***	2½ tsp.	1	
			57% EC	2 tsp.	1	
		Rotenone	4% WP	6 tbsp.	1	
Beans	Aphids	Cygon, De-Fend	2.67 lbs. conc.	1½ tsp.	None	Apply treatment on foliage when aphids appear. Repeat whenever they reappear.
		Malathion	50% EC	2 tsp.	1	
			57% EC	1½ tsp.	1	
			25% WP	5 tbsp.	1	
		Spectracide (Diazinon)	25% EC	2 tsp.	14	
	Bean beetles	Sevin	50% WP	3 tbsp.	None	Apply treatment at first sign of leaf-feeding and repeat whenever leaf-feeding reappears.
			25% Liq.	2 tbsp.	None	
		Methoxychlor	50% WP	2 tbsp.	3	
			25% EC	3 tbsp.	3	
		Malathion	57% EC	1½ tsp.	1	
	Twospotted spider mite	Kelthane	35% WP	1 tbsp.	7	Apply treatment at the first sign of off-color stippling of the foliage and repeat approximately every 2 weeks, if needed.
			18.5% EC	3 tsp.	7	
		Ethion	25% WP	2 tbsp.	2	
	Potato leafhopper	Sevin	50% WP	3 tbsp.	None	Treat when leafhoppers are seen and repeat as needed.
			25% Liq.	2 tbsp.	None	
		Malathion	50% EC	2 tsp.	1	
			57% EC	1½ tsp.	1	
			25% WP	5 tbsp.	1	
		Methoxychlor	50% WP	2 tbsp.	3	
			25% EC	3 tbsp.	3	
		Cygon	2.67 lbs. conc.	1 tsp.	None	
		Diazinon	25% EC	2 tsp.	14	

SPECIAL CONTROL INSTRUCTIONS FOR BEANS

The systemic insecticide Di-Syston will control major pests of beans nearly season-long if applied properly at planting time. Most garden centers sell 1% Di-Syston granules. Since this material is available and does such a good job, it is being recommended here. The gardener **must use this material exactly as suggested below.**

Crop	Pests	How Much To Use	Remarks
Beans	Leafhoppers Mites Bean beetles Thrips	Use 7 ounces per 50 foot of row. (20 tbsp.)	For green or lima beans place 1% granules in a furrow 3 inches away from seed at planting time. Do **not** apply within 60 days of harvest. Do **not** apply directly on seeds.

Note:
Di-Syston is sold in 1¼ and 3 lb. containers. **Do not use more than 7 ounces per 50 foot row.**

Caution:
When using granules avoid breathing granule dust and contact with skin. Keep out of reach of children. Do not reuse the container.

Crop	Pest	Recommended Pesticide	Formulation You Buy	Amount to Add to Make One Gallon of Spray	Days-Waiting-Time From Last Application Until Harvest	When to Treat
Beets	Flea beetles	Sevin	50% WP	3 tbsp.	3 (14 days if tops are to be used as food or feed).	Apply treatment at first sign of tiny, circular holes in the leaves and repeat as needed.
			25% Liq.	2 tbsp.	3	
	Leaf miner and aphids	Spectracide (Diazinon)	25% EC	2 tsp.	14	Treat when white, elongate eggs are seen on underside of leaves, or at the first sign of blotches in the leaves. For aphids apply when they first appear on the foliage and repeat whenever they reappear.
			50% WP	1 tbsp.	14	
		Malathion	50% EC	2 tsp.	7	
			57% EC	1½ tsp.	7	
			25% WP	4 tbsp.	7	

* WP = wettable powder ** Liq. = liquid *** EC = emulsifiable concentrate

INSECT AND MITE CONTROL RECOMMENDATIONS

Crop	Pest	Recommended Pesticide	Formulation You Buy	Amount to Add to Make One Gallon of Spray	Days-Waiting-Time From Last Application Until Harvest	When to Treat
Cabbage **Cauliflower** **Broccoli** **Brussels sprouts**	Aphids	Malathion	50% EC 57% EC 25% WP	2 tsp. 1½ tsp. 1 tbsp.	**Days-Waiting-Time Malathion** Cabbage 7 Cauliflower 7 Brussels sprouts 7 Broccoli 3	Apply treatment when aphids are seen, but before cupping of the leaves occurs. Repeat as aphids reappear.
		Spectracide (Diazinon)	25% EC	2 tsp.		**Cygon** Cabbage 3 Cauliflower 7 Broccoli 7
		Cygon	2.67 lbs. conc.	½ to ¾	**Spectracide** Cabbage 7 Brussels sprouts 7 Cauliflower 5 Broccoli 5	**Thiodan** Cabbage 7 Broccoli 7 Cauliflower 14 Brussels sprouts 14
		Thiodan	3% dust	lb./1,000 sq. ft.	**Sevin** 3 days for all these cole crops. Chinese cabbage 14 days.	**Dipel or Thuricide** No time limitation.
	Cabbage worms	Sevin	50% WP 25% Liq.	4 tbsp. 2½ tbsp.	(See above table)	Apply treatment when worms are very small and repeat every 10 days until harvest.
		Malathion	50% EC 57% EC 25% WP	2 tsp. 1½ tsp. 5 tbsp.		
		Spectracide (Diazinon)	25% EC 50% WP	1 tbsp. 1 tbsp.		
		Thuricide	spores	**(Follow label)**		
		Dipel HG	spores	**(Follow label)**		
	Flea beetles	Sevin	50% WP 25% Liq.	2 tbsp. 1¼ tbsp.	(See above table)	Apply treatment as soon as tiny holes are seen eaten in the foliage and repeat as needed.
		Malathion	50% EC 57% EC 25% WP	2 tsp. 2 tsp. 2 tbsp.		

SPECIAL CONTROL INSTRUCTIONS FOR APHIDS, FLEA BEETLES, LEAFHOPPERS, MITES, AND THRIPS

Crop: **Cabbage** **Cauliflower** **Broccoli** **Brussels sprouts**	1%Di-Syston granules (systemic)	5 oz./50 ft. of row. (14 rounded tablespoonfuls)	Apply as a band on each side of the seed furrow at planting time, or as a sidedressing after plants become established.

(Do not apply more than twice per season for Brussels sprouts, or cauliflower. Make only one application per season for broccoli and cabbage).

Individual transplants: Mix 2 level teaspoonfuls of the insecticide with soil in the transplant hole before setting out plant.

SPECIAL CONTROL INSTRUCTIONS FOR CABBAGE MAGGOT

One of the most destructive early-season pests of cole crops is the cabbage maggot. Infested plants have the lower leaves tinged with yellow, plants fail to grow, and may even wilt and die. Injury results from the maggots feeding on the surface of roots, or tunneling through them. Cabbage maggot flies deposit eggs close to the stem in cracks and crevices in the soil. When the eggs hatch, the young maggots move downward along the stem, feeding as they go. If good control of this pest is to be accomplished, the insecticide must be placed so that the soil immediately adjacent to the stem is saturated.

Crop	Insecticide and How Much To Use Per Gallon of Water	Remarks
Cabbage Cauliflower Broccoli Brussels sprouts	**Transplant water treatment:** Spectracide (Diazinon) 25% liquid concentrate at 2 teaspoonfuls per gallon of water.	Apply 1 cupful of the mixture into the transplanting hole.
	Post-transplanting soil drench: Spectracide (Diazinon) 25% liquid concentrate at 2 tablespoonfuls per gallon of water.	Apply a drenching spray to the center of the plant and downward along the stalk to wet the soil around the stem. This treatment needs to be made every 10 days. See note for days-waiting-time from last application until harvest.

Note: Do not apply Spectracide (Diazinon) within 7 days of harvest for cabbage and Brussels sprouts; nor 5 days for cauliflower and broccoli.

Note: If your hands must come in contact with treated soil, then you should wear rubber gloves.

Crop	Pest	Recommended Pesticide	Formulation You Buy	Amount to Add to Make One Gallon of Spray	Days-Waiting-Time From Last Application Until Harvest	When to Treat
Carrots	Sixspotted Leafhopper	Sevin	50% WP 25% Liq.	2 tbsp. 1¼ tbsp.	None None	This leafhopper transmits a disease called carrot yellows. For control, apply treatment when first leafhoppers are seen and repeat as needed.
		Malathion	50% EC 57% EC 25% WP	2 tsp. 1½ tsp. 6 tbsp.	7 7 7	
		Spectracide (Diazinon)	25% EC	2 tsp.	10	

Note: Carrots should not be planted in chlordane-treated soil (see Table 2, page 7).

INSECT AND MITE CONTROL RECOMMENDATIONS

Crop	Pest	Recommended Pesticide	Formulation You Buy	Amount to Add to Make One Gallon of Spray	Days-Waiting-Time From Last Application Until Harvest	When to Treat
Cucumbers	Cucumber beetle	Sevin	50% WP	2 tbsp.	None	Make first application as soon as the young plants start to break through the soil surface and repeat at 5-day intervals. If rain comes within the 5-day period, repeat the treatment promptly and then return to the regular 5-day treatment interval. Malathion may cause injury to plants if applied before they start to vine. Malathion and Sevin should not be combined for application to cucumbers due to phototoxicity.
			25% Liq.	1¼ tbsp.	None	
		Malathion	50% EC	3½ tsp.	1	
			57% EC	2½ tsp.	1	
			25% WP	7 tbsp.	1	
		Methoxychlor	50% WP	1¾ tbsp.	1	
			25% EC	7 tsp.	1	
		Thiodan	3% dust	½ to ¾ lb./ 1,000 sq. ft.	None	
	Aphids	Malathion	50% EC	2 tsp.	1	Aphids transmit a mosaic disease. The repeated use of methoxychlor may cause a build-up of aphids. Apply treatment when aphids appear and repeat as needed.
			57% EC	1½ tsp	1	
			25% WP	2 tbsp.	1	
		Metasystox-R (No more than 2 applications per season)	2 lbs. conc.	2 tsp.	None	
		Spectracide (Diazinon)	25% EC	2 tsp.	7	
		Thiodan	3% dust	½ to ¾ lb./ 1,000 sq. ft.	None	
	Mites	Kelthane	35% WP	1 tbsp.	2	Apply treatment when mites appear and repeat as needed.
			18.5% EC	3 tsp.	2	
		Ethion	25% WP	2 tbsp.	None	
			4 lbs. conc.	1 tsp.	None	
		Spectracide (Diazinon)	25% EC	1 tbsp.	7	
Eggplant	Flea beetle	Sevin	50% WP	2 tbsp.	None	Apply treatment at first sign of tiny holes in the leaves and repeat as needed.
			25% Liq.	1¼ tbsp.	None	
		Malathion	50% EC	2 tsp.	3	
			57% EC	1½ tsp.	3	
			25% WP	2 tbsp.	3	
		Thiodan	3% dust	½ lb./ 1 000 sq. ft.	1	
	Mites	Ethion	25% WP	2 tbsp.	None	Apply treatment when mites appear and repeat as needed.
			4 lbs. conc.	1 tsp.	None	
	Aphids	Dibrom	60% EC	2 tsp.	1	Aphids transmit a mosaic disease. The repeated use of methoxychlor may cause a build-up of aphids. Apply treatment when aphids appear and repeat as needed.
		Malathion	50% EC	2 tsp.	3	
			57% EC	1½ tsp.	3	
			25% WP	2 tbsp.	3	
		Thiodan	3% dust	½ to ¾ lb./ 1,000 sq. ft.	1	
Muskmelons	Cucumber beetles	Sevin	50% WP	2 tbsp.	None	Make first application as soon as the young plants start to break through the soil surface and repeat at 5-day intervals. If rain comes within the 5-day period, repeat the treatment promptly and then return to the regular 5-day treatment interval. Malathion may cause injury to plants if applied before they start to vine. Malathion and Sevin should not be combined for application to muskmelons due to phototoxicity.
			25% Liq.	1¼ tbsp.	None	
		Malathion	50% EC	3½ tsp.	1	
			57% EC	2½ tsp.	1	
			25% WP	7 tbsp.	1	
		Methoxychlor	50% WP	1¾ tbsp.	1	
			25% EC	7 tsp.	1	
		Thiodan	3% dust	½ to ¾ lb./ 1,000 sq. ft.	None	
	Aphids	Metasystox-R (No more than 3 application per season)	2 lbs. conc.	2 tsp.	14	Aphids transmit a mosaic disease. The repeated use of methoxychlor may cause a build-up of aphids. Apply a treatment when aphids appear and repeat as needed.
		Malathion	50% EC	2 tsp.	1	
			57% EC	1½ tsp.	1	
			25% WP	6 tbsp.	1	
		Spectracide (Diazinon)	25% EC	2 tsp.	3	
		Cygon	2.67 lbs. conc.	1 tsp.	3	
		Thiodan	3% dust	½ lb./ 1,000 sq. ft.	None	
	Mites	Kelthane	35% WP	1 tbsp.	2	Apply treatment when mites appear and repeat as needed.
			18.5% EC	3 tsp.	2	
		Ethion	25% EC	2 tbsp.	None	
			4 lbs. conc.	1 tsp.	None	
		Spectracide (Diazinon)	25% EC	1 tbsp.	3	

INSECT AND MITE CONTROL RECOMMENDATIONS

Crop	Pest	Recommended Pesticide	Formulation You Buy	Amount to Add to Make One Gallon of Spray	Days-Waiting-Time From Last Application Until Harvest	When to Treat
Onions	Thrips	Malathion	50% EC	2 tsp.	3	Make treatment when elongate, light-colored marks first appear on onion leaves and repeat at 10-day intervals as needed.
			57% EC	1½ tsp.	3	
			25% WP	6 tbsp.	3	
		Spectracide (Diazinon)	25% EC	2 tsp.	10	

SPECIAL CONTROL INSTRUCTIONS FOR ONION MAGGOT

Onion maggots burrow into developing bulbs of onion and cause the plants to turn yellow, wilt, and die. Cool, wet weather favors the development of serious infestations. Use Spectracide (Diazinon) 25% emulsifiable concentrate at 2 teaspoonfuls per gallon of water and apply a liberal amount into an open trench in which the bulbs are to be set, or Diazinon 4% dust at 6 tbsp./100 foot of row.

Crop	Pest	Recommended Pesticide	Formulation You Buy	Amount to Add to Make One Gallon of Spray	Days-Waiting-Time From Last Application Until Harvest	When to Treat
Peas	Aphids	Malathion	50% EC	2 tsp.	3	Apply treatment when aphids first appear and repeat as often as necessary.
			57% EC	1½ tsp.	3	
		Spectracide (Diazinon)	50% WP	1 tbsp.	None	
			25% EC	2 tsp.	None	
		Cygon, De-Fend	2.67 lbs. conc.	½ tsp.	None	
		Di-Syston 1% granules (systemic)		2½ oz./50 ft. of row (7 rounded tablespoons)		Apply at planting time only as a band on each side of the seed furrow.
Peppers	Aphids	Malathion	50% EC	2 tsp.	3	Apply treatment when aphids first appear and repeat as needed.
			57% EC	1½ tsp.	3	
			25% WP	2 tbsp.	3	
		Spectracide (Diazinon)	25% EC	2 tsp.	5	
			50% WP	½ tbsp.	5	
		Thiodan	3% dust	¾ lb./1,000 sq. ft.	1	Do not apply more than twice per season.
		Metasystox-R	2 lbs. conc.	2 tsp.	None	

SPECIAL CONTROL INSTRUCTIONS FOR EUROPEAN CORN BORER ON PEPPERS

The European corn borer is a very serious pest of peppers. The more serious borer infestations are caused by the second generation of worms, which is present in July and August. The adult moth lays eggs on the pepper leaves; the eggs hatch and the borers burrow and feed inside the pepper unnoticed. Infested peppers have severe decay inside and are unfit to eat.

To prevent borer damage, apply Sevin 50% wettable powder at 2 tablespoonfuls per gallon of water. Apply thoroughly to the pepper plants, especially to the pepper caps, every 3 days after blossoms appear and fruit forms. Damage is more likely to occur in late July and August. Sevin may be used the day of picking.

Crop	Pest	Recommended Pesticide	Formulation You Buy	Amount to Add to Make One Gallon of Spray	Days-Waiting-Time From Last Application Until Harvest	When to Treat
Potatoes	Flea beetles and Leafhoppers	Sevin	50% WP	2 tbsp.	None	Apply treatment for flea beetles as soon as plants appear above ground and repeat as needed.
		Spectracide (Diazinon)	25% EC	2 tsp.	35	
	Potato beetle	Thiodan	3% dust	¾ lb./1,000 sq. ft.	None	For leafhoppers, treat when leafhoppers are seen and repeat as needed.
	Aphids	Metasystox-R	2 lbs. conc.	2 tsp.	7	Apply treatment to foliage when aphids appear during July and repeat as needed.
		Spectracide (Diazinon)	25% EC	2 tsp.	35	
			50% WP	1 tbsp.	35	
		Cygon, De-Fend	2.67 lbs. conc.	1½ tsp.	None	
		Malathion	50% EC	2 tsp.	None	
			57% EC	1½ tsp.	None	
			25% WP	3 tbsp.	None	
		Thiodan	3% dust	¾ lb./1,000 sq. ft.	None	

Note: Aphids generally appear on potato foliage during July. For best results use Metasystox-R beginning the 3rd week in July and make an application every 10 days through the month of August. Aphids can greatly reduce yields if left unmanaged.

Crop	Pest	Recommended Pesticide	Formulation You Buy	Amount to Add to Make One Gallon of Spray	Days-Waiting-Time From Last Application Until Harvest	When to Treat
	Soil pests (wireworms, white grubs, cutworms)	Chlordane	45% EC	8 tbsp./1,000 sq. ft. soil	Preplanting treatment	Apply treatment to spaded ground and work into the top 3-5" of soil, then plant potatoes. One application of chlordane should be effective for 3 seasons, or more. Spectracide (Diazinon) only lasts one season.
			75% EC	4 tbsp./1,000 sq. ft. soil		
			40% WP	12 tbsp./1,000 sq. ft. soil		
		Spectracide (Diazinon)	25% EC	16 tbsp./15 gal. water/1,000 sq. ft.		
			50% WP	8 tbsp.		
		Diazinon	4% dust	Spread evenly over soil and mix in.		

SPECIAL CONTROL INSTRUCTIONS FOR MAJOR POTATO PESTS

The systemic insecticide Di-Syston will give season-long control of the major potato pests if applied properly at planting time. Most garden centers sell 1% Di-Syston granules. If this material is purchased, **use it exactly as suggested below.**

Crop	Pests	How Much To Use	Remarks
Potatoes	Flea beetles Leafhoppers Colorado potato beetle	13 ounces per 50 foot of row.	Place granules in seed furrow at planting time. **Do not** apply within 75 days of harvest.

Note:

Di-Syston is sold in 1¼ and 3 lb containers. **Do not use more than 13 ounces per 50 ft. of row.**

Caution:

When using granules avoid breathing granules dust and contact with skin. Keep out of reach of children. **Do not** reuse the container.

INSECT AND MITE CONTROL RECOMMENDATIONS

Crop	Pest	Recommended Pesticide	Formulation You Buy	Amount to Add to Make One Gallon of Spray	Days-Waiting-Time From Last Application Until Harvest	When to Treat
Pumpkins and Squash	Cucumber beetle	Sevin	50% WP	2 tbsp.	None	Make first application as soon as the young plants start to break through the soil surface and repeat at 5-day intervals. If rain comes within the 5-day period, repeat the treatment promptly and then return to the regular 5-day treatment interval. Malathion may cause injury to plants if applied before they start to vine. Malathion and Sevin should not be combined for application to muskmelons due to phototoxicity.
			25% Liq.	1¼ tbsp.	None	
		Malathion	50% EC	3½ tsp.	3 pumpkin, 1 squash	
			57% EC	2½ tsp.	3 pumpkin, 1 squash	
			25% WP	7 tbsp.	3 pumpkin, 1 squash	
		Methoxychlor	50% WP	1¾ tbsp.	1	
			25% EC	7 tsp.	1	
	Squash bug	Sevin	50% WP	2 tbsp.	None	Adults and brown egg-masses can be hand-picked from plants. Adults may be trapped under shingles placed beneath the plants. If you don't hand-pick, or trap, apply insecticide when bugs appear and repeat as needed.
			25% Liq.	1¼ tbsp.	None	
	Aphids	Malathion	50% EC	3½ tsp.	3 pumpkin, 1 squash	Apply treatment when aphids first appear and repeat as needed.
			57% EC	2½ tsp.	3 pumpkin, 1 squash	
			25% WP	4 tbsp.	3 pumpkin, 1 squash	
		Diazinon	25% EC	2 tsp.	7 pumpkin, 7 squash	
	Vine borer	Malathion	50% EC	3½ tsp.	3 pumpkin, 1 squash	Apply treatment 5 times at 7-day intervals beginning the last week in June. Direct insecticides at base of plants.
			57% EC	2½ tsp.	3 pumpkin, 1 squash	
			25% WP	7 tbsp.	3 pumpkin, 1 squash	
		Methoxychlor	50% WP	1¾ tbsp.	1	
			25% EC	7 tsp.	1	
Radishes	Flea beetle	Sevin	50% WP	2 tbsp.	3	Apply treatment when small, circular holes are seen in the leaves and repeat as needed.
			25% Liq.	1¼ tbsp.	3	
		Spectracide (Diazinon)	25% EC	2 tsp.	10	
	Aphids	Malathion	50% EC	2 tsp.	7	Apply treatment when aphids first appear and repeat as needed.
			57% EC	1½ tsp.	7	
			25% WP	2 tbsp.	7	
		Spectracide (Diazinon)	50% WP	1 tbsp.	10	
			25% EC	2 tsp.	10	

SPECIAL CONTROL INSTRUCTIONS FOR RADISH MAGGOT

The radish maggot makes shallow runways on the fleshy part of radishes making them unfit to eat. The maggots can be controlled by mixing Spectracide (Diazinon) 25% emulsifiable concentrate at 2 tablespoonfuls per gallon of water and applying it as follows:

Seed furrow treatment: Apply a liberal amount of the spray mixture to the open trench before the seeds are placed in it.

Post-emergence treatment: As a supplement to the seed furrow treatment, apply a drenching spray to the radish plants after they have emerged from the soil. Direct spray to soil around stem of plant. **Repeat** treatment every week for best results. Spectracide may be applied to within 10 days of harvest, or Diazinon 4% dust at 9 tbsp./100 foot of row.

Crop	Pest	Recommended Pesticide	Formulation You Buy	Amount to Add to Make One Gallon of Spray	Days-Waiting-Time From Last Application Until Harvest	When to Treat
Sweet corn	Flea beetles	Sevin	50% WP	3 tbsp.	None	Flea beetles are carriers of Stewart's disease. Apply treatment when plants emerge through the soil and repeat 2 or 3 times at 5-day intervals. Early applications are important if infection is to be prevented.
			25% Liq.	2 tbsp.	None	
		Spectracide (Diazinon)	25% EC	2 tsp.	None	
	Corn earworm	Sevin	50% WP	4 tbsp.	None	Make treatment when first silks are seen and repeat every 3 days until all silks have turned brown and dried-up. Under ideal growing conditions of the silks, the treatment interval should be shortened to every 2 days.
			25% Liq.	2½ tbsp.	None	
		Spectracide (Diazinon)	25% EC	4 tsp.	None	
	Sap beetles	Sevin	50% WP	2 tbsp.	None	Sap beetles migrate to gardens in search of overripe or cracked fruits including damaged ears of corn. Make an effort to harvest the corn as soon as it is ripe. Remove all fallen, or rotten fruits from the vicinity of the garden. Apply treatment if the above is not practiced. Repeat treatments as needed.
			25% Liq.	1¼ tbsp.	None	
		Spectracide (Diazinon)	25% EC	2 tbsp.	None	

SPECIAL CONTROL INSTRUCTIONS FOR EUROPEAN CORN BORER ON SWEET CORN

The European corn borer moth is an insect which lays its eggs on the leaves of corn. The worms which hatch from the eggs enter the whorl of the plant (funnel part) and eventually bore into the stalk. Yields are reduced and plants often breakover. A later generation of the borer enters the ear shank and/or the tassel.

To control the European corn borer, apply Sevin 50% wettable powder at 3 tablespoonfuls per gallon of water at 5-day intervals when the first sign of small feeding scars are noticed on the leaves. Apply the spray into the plant whorl. Sevin may be applied the day of harvest.

INSECT AND MITE CONTROL RECOMMENDATIONS

Crop	Pest	Recommended Pesticide	Formulation You Buy	Amount to Add to Make One Gallon of Spray	Days-Waiting-Time From Last Application Until Harvest	When to Treat
Tomatoes						

SPECIAL CONTROL FOR APHIDS, FLEA BEETLES, LEAFHOPPERS, LEAF MINERS, AND MITES

Di-Syston 1% systemic granules in rows 36" apart. Use 12 ounces (33 tablespoonfuls) per 50 ft. of row at planting time only. Apply as a band on each side of the seed furrow.

Individual transplants: Mix 2 rounded teaspoons of the insecticide with soil in the transplant hole before setting out plant.

Crop	Pest	Recommended Pesticide	Formulation You Buy	Amount to Add to Make One Gallon of Spray	Days-Waiting-Time From Last Application Until Harvest	When to Treat
	Cutworms	Sevin	50% WP 25% Liq.	4 tbsp. 2½ tbsp.	None None	Apply Sevin when plants are first set and repeat two more times at weekly intervals. For Spectracide, apply 15 fluid ounces per 1,000 sq. ft. of soil in sufficient water to obtain thorough coverage. Mix chemical into the top 4" of soil, then set plants.
		Spectracide (Diazinon)	25% EC	15 fluid oz.	1	
		Thiodan	3% dust	¾ lb./ 1,000 sq. ft.	1	
	Flea beetles and Blister beetles	Sevin	50% WP 25% Liq.	2 tbsp. 1¼ tbsp.	None None	For flea beetles, more important protection should come the first two weeks after plants are set. Apply insecticides after plants are set and repeat as needed. For blister beetles, treatment is needed later in the season when blister beetles are first seen on the plants. Repeat as needed.
		Methoxychlor	50% WP 25% EC	1¾ tbsp. 7 tsp.	1 1	
		Thiodan (Flea beetles)	3% dust	¾ lb./ 1,000 sq. ft.	1	
		(Diazinon)	25% EC	2 tsp.	1	
	Aphids	Malathion	50% EC 57% EC 25% WP	2 tsp. 1½ tsp. 2 tbsp.	1 1 1	Apply treatment when aphids are seen and repeat as needed.
		Spectracide (Diazinon)	25% EC 50% WP	1 tsp. ½ tsbp.	1 1	
		Thiodan	3% dust	¾ lb./ 1,000 sq. ft.	1	
	Hornworm and Fruitworm	Sevin	50% WP 25% Liq.	3 tbsp. 2 tbsp.	None None	Hand-pick worms when eaten foliage is noticed, or apply insecticide as needed.
		Thuricide	spores	**(Follow label)**		
		Dipel HG	spores	**(Follow label)**		
	Whitefly	Malathion	57% EC 25% WP	1 tbsp. 4 tbsp.	1 1	Best suggestion is to inspect underside of leaves at place of purchase. Do not buy if tiny, oblong, white, motionless structures are observed. These are young whiteflies. For treatment: When tiny whiteflies can be jarred from the foliage, begin treatment and repeat at 15-day intervals for 3 applications and repeat procedure as needed.
	Sap beetles	Sevin	50% WP 25% Liq.	2 tbsp. 1¼ tbsp.	None None	Buy crack-resistant varieties. Sap beetles migrate to gardens in search of overripe, or cracked fruits. Make an effort to harvest fruits as soon as they are ripe. Remove any fallen, or rotten fruits from the vicinity of the garden. Apply treatment if the above is not practiced. Repeat treatment as needed.
Turnips	Flea beetle	Sevin	50% WP 25% Liq.	2 tbsp. 1¼ tbsp.	3 (14 days if tops 3 are to be used as food or feed.)	Apply treatment when small, circular holes are first seen in turnip leaves and repeat as needed.
		Spectracide (Diazinon)	25% EC	2 tsp.	10	
	Aphids	Malathion	50% EC 57% EC 25% WP	2 tsp. 1½ tsp. 4 tbsp.	3 3 3	Apply treatment when aphids are seen and repeat as needed.
		Spectracide (Diazinon)	50% WP 25% EC	1 tbsp. 2 tsp.	10 10	
		Metasystox-R	2 lbs. conc.	2 tsp.	7	Do not apply within 28 days of harvest if tops are to be used. Make no more than 2 applications per season.

SPECIAL CONTROL INSTRUCTIONS FOR TURNIP MAGGOT

The turnip maggot makes shallow runways on the fleshy part of turnips making them unfit to eat. The maggots can be controlled by mixing Spectracide (Diazinon) 25% emulsifiable concentrate at 2 tablespoonfuls per gallon of water and applying it as follows:

Seed furrow treatment: Apply a liberal amount of the spray mixture to the open trench before the seeds are placed in it.

Post-emergence treatmnt: As a supplement to the seed furrow treatment, apply a drenching spray to the turnip plants after they have emerged from the soil. Direct spray to soil around stem of plant. **Repeat** treatment every week for best results. Spectracide may be applied to within 10 days of harvest.

INSECT AND MITE CONTROL RECOMMENDATIONS

Crop	Pest	Recommended Pesticide	Formulation You Buy	Amount to Add to Make One Gallon of Spray	Days - Waiting - Time From Last Application Until Harvest	When to Treat
Watermelons	Cucumber beetles	Sevin	50% WP	2 tbsp.	None	Make first application as soon as the young plants start to break through the soil surface and repeat at 5-day intervals. If rain comes within the 5-day period, repeat the treatment promptly and then return to the regular 5-day treatment interval. Malathion may cause injury to plants if applied before they start to vine. Malathion and Sevin should not be combined for application to watermelon plants due to phototoxicity.
			25% Liq.	1¼ tbsp.	None	
		Malathion	50% EC	3½ tsp.	1	
			57% EC	2½ tsp.	1	
			25% WP	7 tbsp.	1	
		Methoxychlor	50% WP	1¾ tbsp.	1	
			25% EC	7 tsp	1	
	Aphids	Malathion	50% EC	2 tsp.	1	Apply treatment when aphids appear and repeat as needed. (Do not use Metasystox-R more than twice per season.)
			57% EC	1½ tsp.	1	
			25% WP	4 tbsp.	1	
		Metasystox-R	2 lbs. conc.	2 tsp.	7	
		Spectracide (Diazinon)	25% EC	2 tsp.	3	
		Cygon	2.67 lbs. conc.	1 tsp.	3	
	Mites	Kelthane	35% WP	1 tbsp.	2	Apply treatment when mites are seen, or foliage shows stippling Repeat as needed.
			18.5% EC	2 tsp.	2	
		Ethion	25% WP	2 tbsp.	None	
			4 lbs. conc.	1 tsp.	None	
		Spectracide (Diazinon)	25% EC	2 tsp.	3	

OHIO POISON INFORMATION CENTERS

The poison information centers are listed below. Be sure your doctor has this list and the "note to physicians" that comes on dangerous pesticide labels. Your doctor should know in advance what dangerous pesticides you plan to use so he can relay the right chemical name to the poison information center in case of emergency. Treatment for pesticide poisoning is very exacting. In an emergency, you could call the poison information center, but it is preferable to let your doctor consult the center in order to avoid mistakes.

AKRON: 44308
Children's Hospital, W. Buchtel and W. Bowery
PHONE: 216-379-8562

CANTON: 44710
Aultman Hospital, 2600 6th St., SW
PHONE: 216-452-9911

CINCINNATI: 45267
General Hospital, 234 Goodman St.
PHONE: 513-872-5111

CLEVELAND: 44106
Cleveland Academy of Medicine, 10525 Carnegie Avenue
PHONE: 216-231-4455 (Emergency)
216-231-3500 (Office)

COLUMBUS: 43205
Children's Hospital, 561 South 17th St. at Livingston Park
PHONE: 614-228-1323

DAYTON: 45433
USAF Hospital, Wright-Patterson Air Force Base
PHONE: 513-257-2969

LORAIN: 44053
Lorain Community Hospital, 3700 Kolbe Rd.
PHONE: 216-282-2220

MANSFIELD: 44903
Mansfield General Hospital, 335 Glessner Avenue
PHONE: 419-522-3411, Ext. 545

SPRINGFIELD: 45502
Community Hospital, E. High St. and Burnett Road
PHONE: 513-325-0531

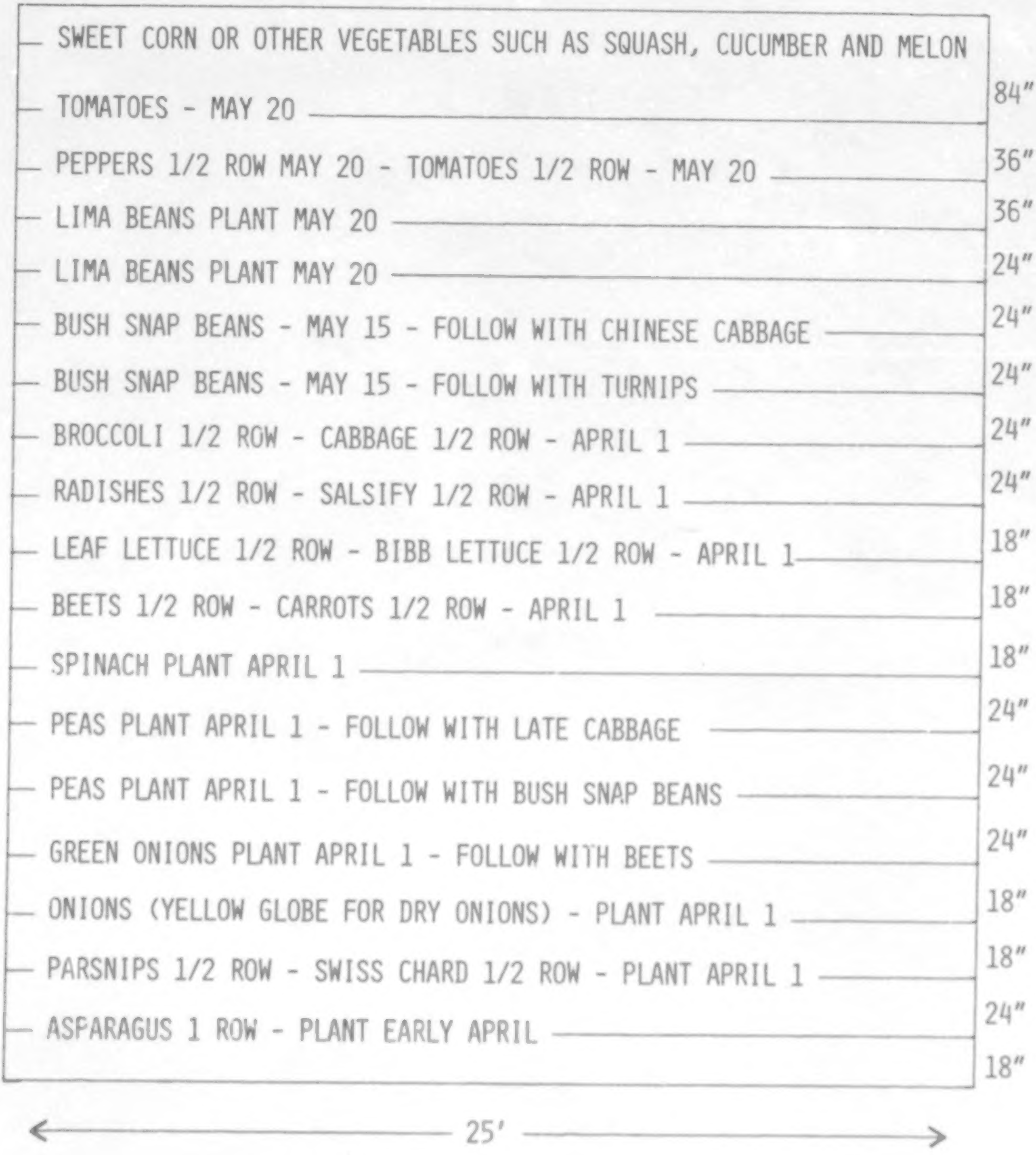
TOLEDO: 43609
MCOT Hospital, 2025 Arlington Avenue
PHONE: 419-382-7971

YOUNGSTOWN: 44505
St. Elizabeth Hospital, 1044 Belmont Avenue
PHONE: 216-746-7231, Ext. 401 or 402

For emergency consultation, physicians or hospital representatives may also call U. S. Environmental Protection Agency, 4770 Bulford Highway, Chamblee, Georgia 30341. PHONE: Office 404-633-3311, Ext. 3211.

SAMPLE FAMILY VEGETABLE GARDEN PLANT

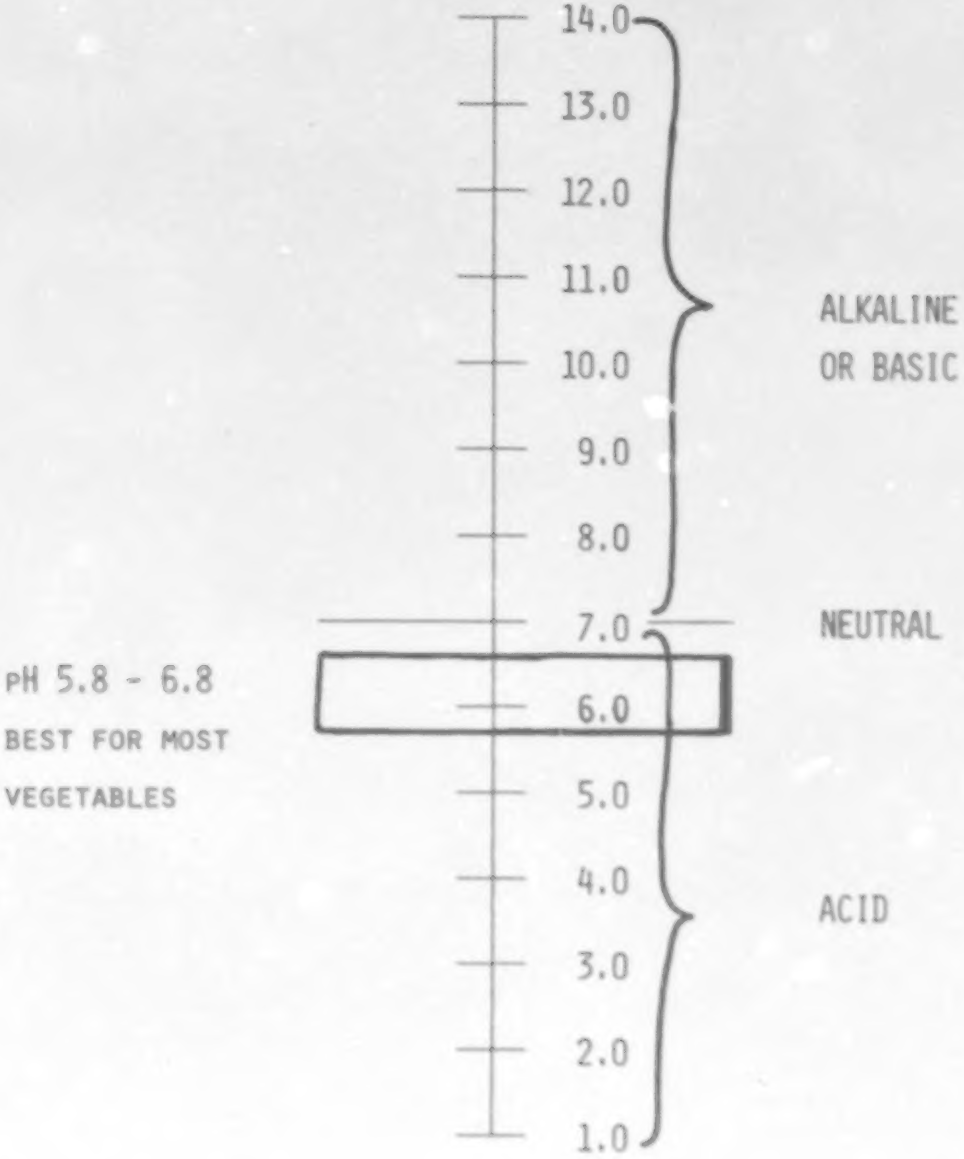
(TO BE USED AS GUIDE FOR YOUR SPECIFIC NEEDS)


SWEET CORN OR OTHER VEGETABLES SUCH AS SQUASH, CUCUMBER AND MELON
84"
TOMATOES - MAY 20
36"
PEPPERS 1/2 ROW MAY 20 - TOMATOES 1/2 ROW - MAY 20
36"
LIMA BEANS PLANT MAY 20
24"
LIMA BEANS PLANT MAY 20
24"
BUSH SNAP BEANS - MAY 15 - FOLLOW WITH CHINESE CABBAGE
24"
BUSH SNAP BEANS - MAY 15 - FOLLOW WITH TURNIPS
24"
BROCCOLI 1/2 ROW - CABBAGE 1/2 ROW - APRIL 1
24"
RADISHES 1/2 ROW - SALSIFY 1/2 ROW - APRIL 1
18"
LEAF LETTUCE 1/2 ROW - BIBB LETTUCE 1/2 ROW - APRIL 1
18"
BEETS 1/2 ROW - CARROTS 1/2 ROW - APRIL 1
18"
SPINACH PLANT APRIL 1
24"
PEAS PLANT APRIL 1 - FOLLOW WITH LATE CABBAGE
24"
PEAS PLANT APRIL 1 - FOLLOW WITH BUSH SNAP BEANS
24"
GREEN ONIONS PLANT APRIL 1 - FOLLOW WITH BEETS
18"
ONIONS (YELLOW GLOBE FOR DRY ONIONS) - PLANT APRIL 1
18"
PARSNIPS 1/2 ROW - SWISS CHARD 1/2 ROW - PLANT APRIL 1
24"
ASPARAGUS 1 ROW - PLANT EARLY APRIL
18"
25'

SEED IDENTIFICATION

SEED NAME	COLOR	SIZE	SHAPE	OTHER CHARACTERISTICS

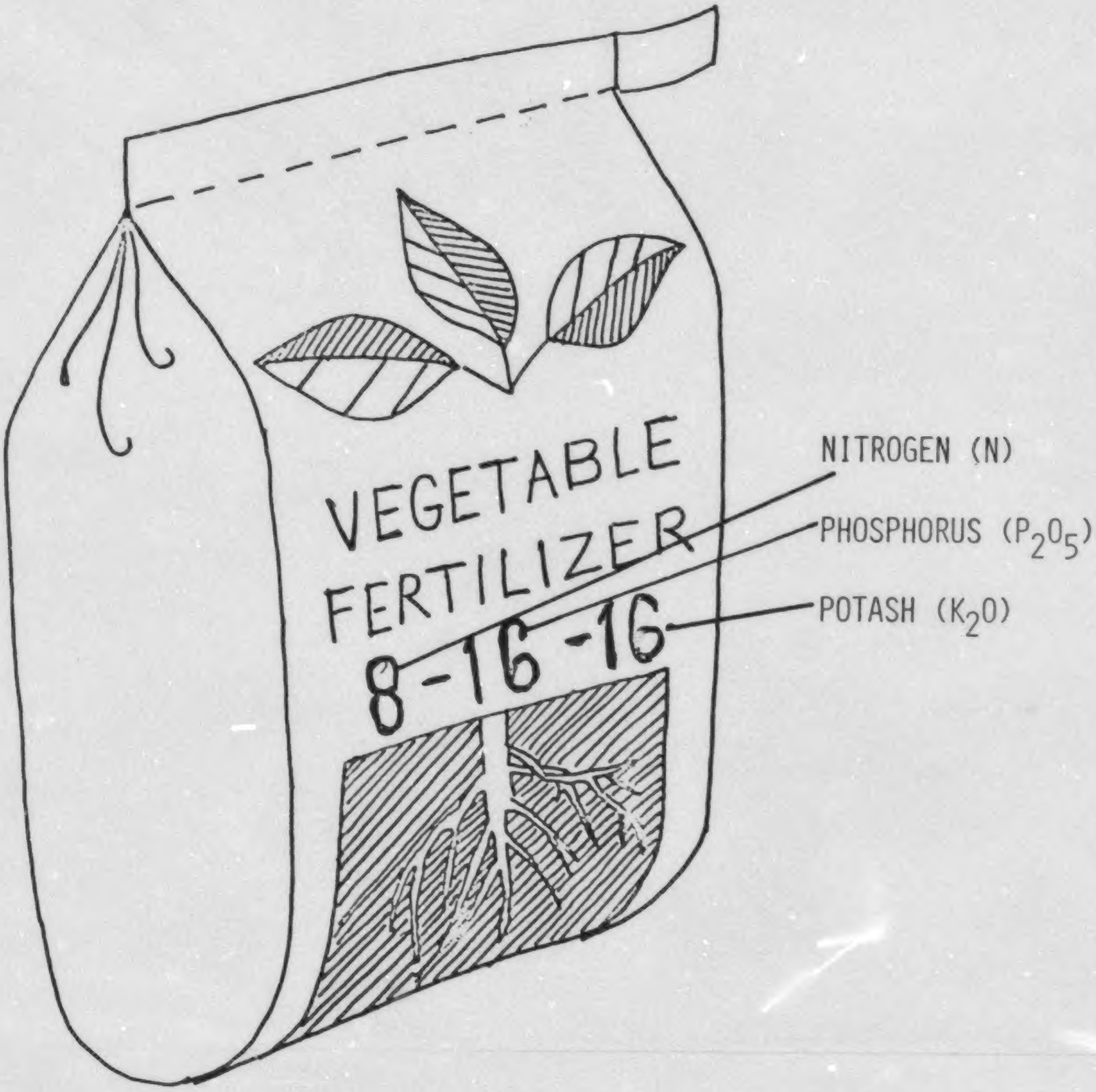
pH SCALE


14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
ALKALINE OR BASIC
NEUTRAL
ACID
pH 5.8 - 6.8
BEST FOR MOST VEGETABLES

A SOIL pH LEVEL OF 5.8 TO 6.8 IS BEST FOR MOST VEGETABLES.

T-3

STARTER FERTILIZER


VEGETABLE
FERTILIZER
8-16-16
NITROGEN (N)
PHOSPHORUS (P_2O_5)
POTASH (K_2O)

LIMING

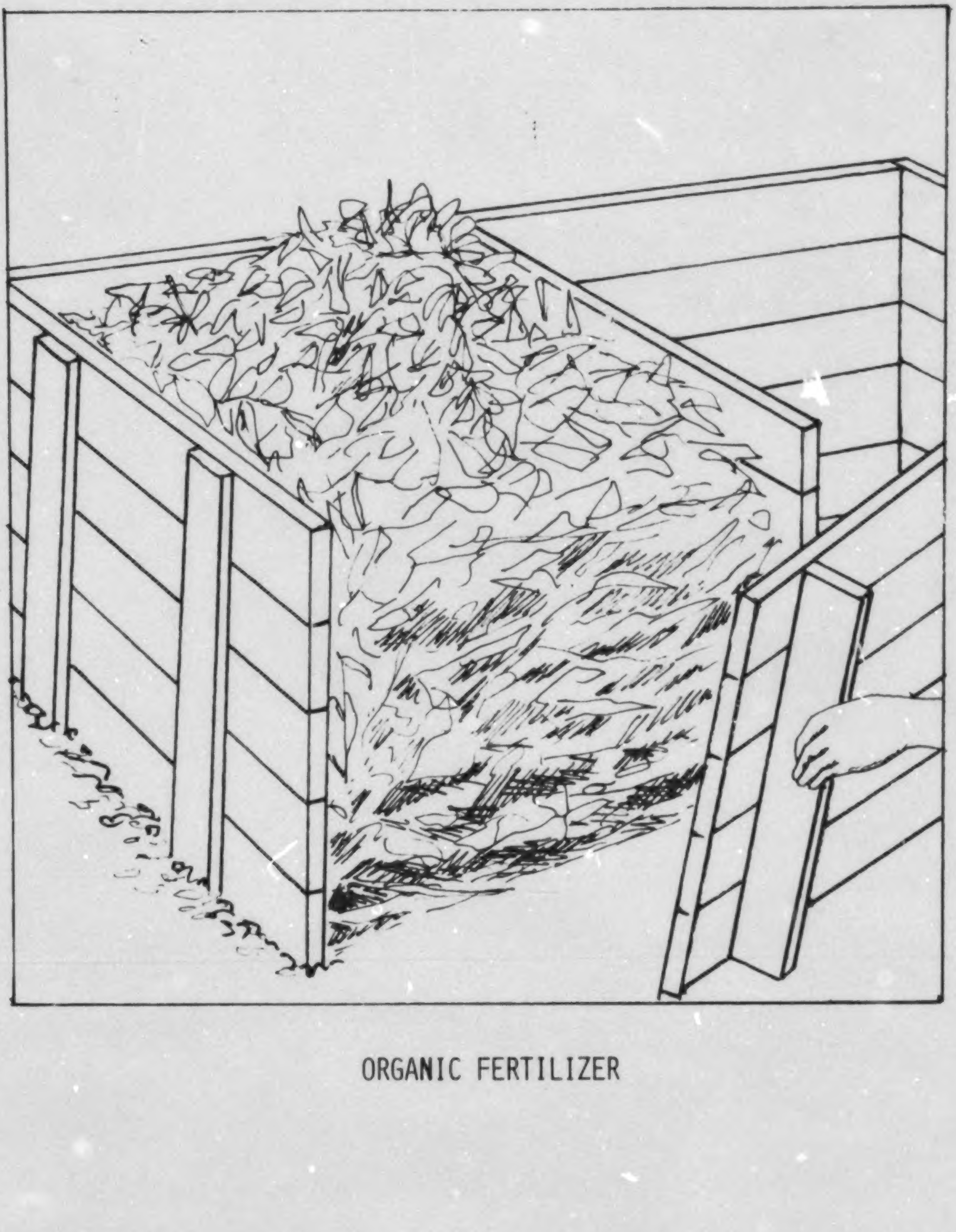
In general, about 5 pounds of ground limestone per 100 square feet of garden space every 5 years will maintain the proper level.

On light, colored soils that have never been limed, apply 15 to 20 pounds of ground limestone per 100 square feet as an initial application.

FERTILIZATION

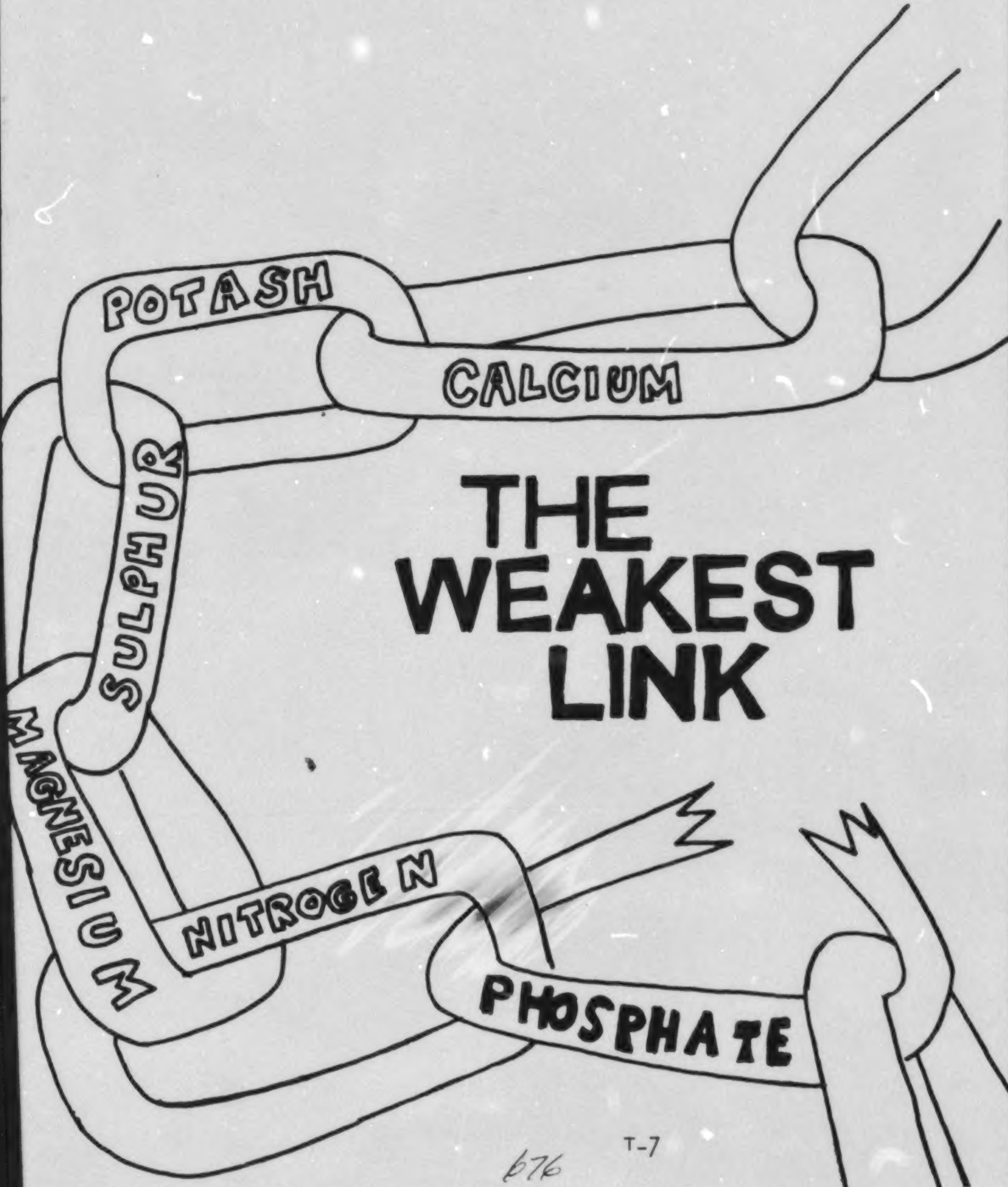
Broadcast 2 pounds per 100 square feet of garden space and work into the soil to a depth of two or three inches prior to planting.

Band application makes the most efficient use of a small amount of fertilizer. Band applications are made so that the seed or roots do not come in contact with the fertilizer. The fertilizer is applied in a small furrow about 3 inches to each side of the row and 2 to 3 inches deep.



ORGANIC FERTILIZER

PLANT NUTRIENTS


POTASH
CALCIUM
SULPHUR
THE WEAKEST LINK
MAGNESIUM
NITROGEN
PHOSPHATE

ESSENTIAL GARDENING OPERATIONS

1. SOIL PREPARATION INCLUDING CONDITIONING TO MODIFY UNDESIRABLE SOIL STRUCTURES. CLAYEY SOILS CAN BE IMPROVED BY ADDING HUMUS (ORGANIC MATTER).

2. MAINTAINING OR INCREASING SOIL FERTILITY.

3. PROPER PLANTING AND THINNING OF CROPS WHEN NECESSARY.

4. CONTROLLING WEEDS.

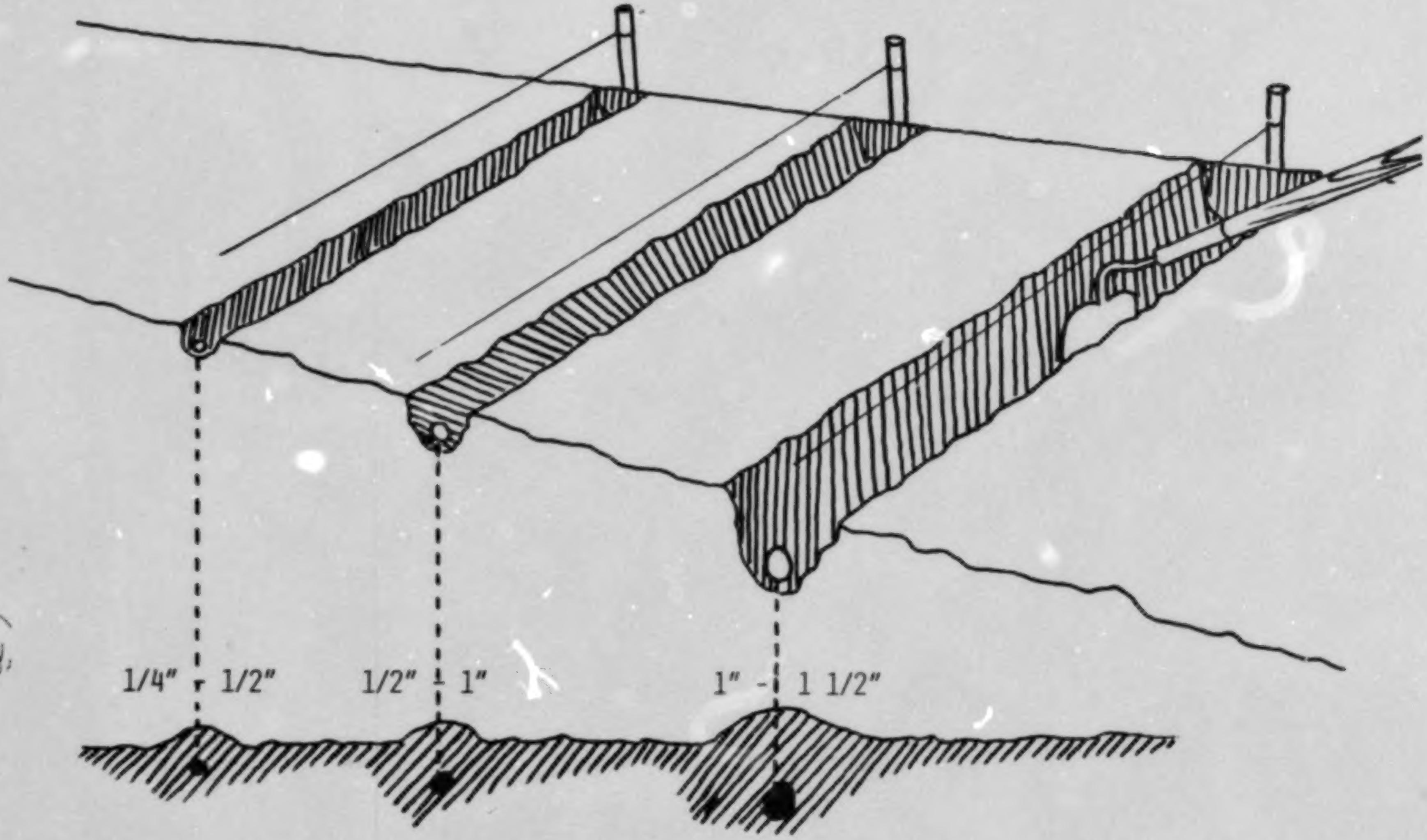
5. PREVENTING INSECTS AND DISEASE DAMAGE OF PLANTS AND SAFETY TO THE GARDENER AND OTHER INDIVIDUALS.

6. MAINTAINING ADEQUATE SOIL MOISTURE.

MINIMUM TOOLS AND SUPPLIES

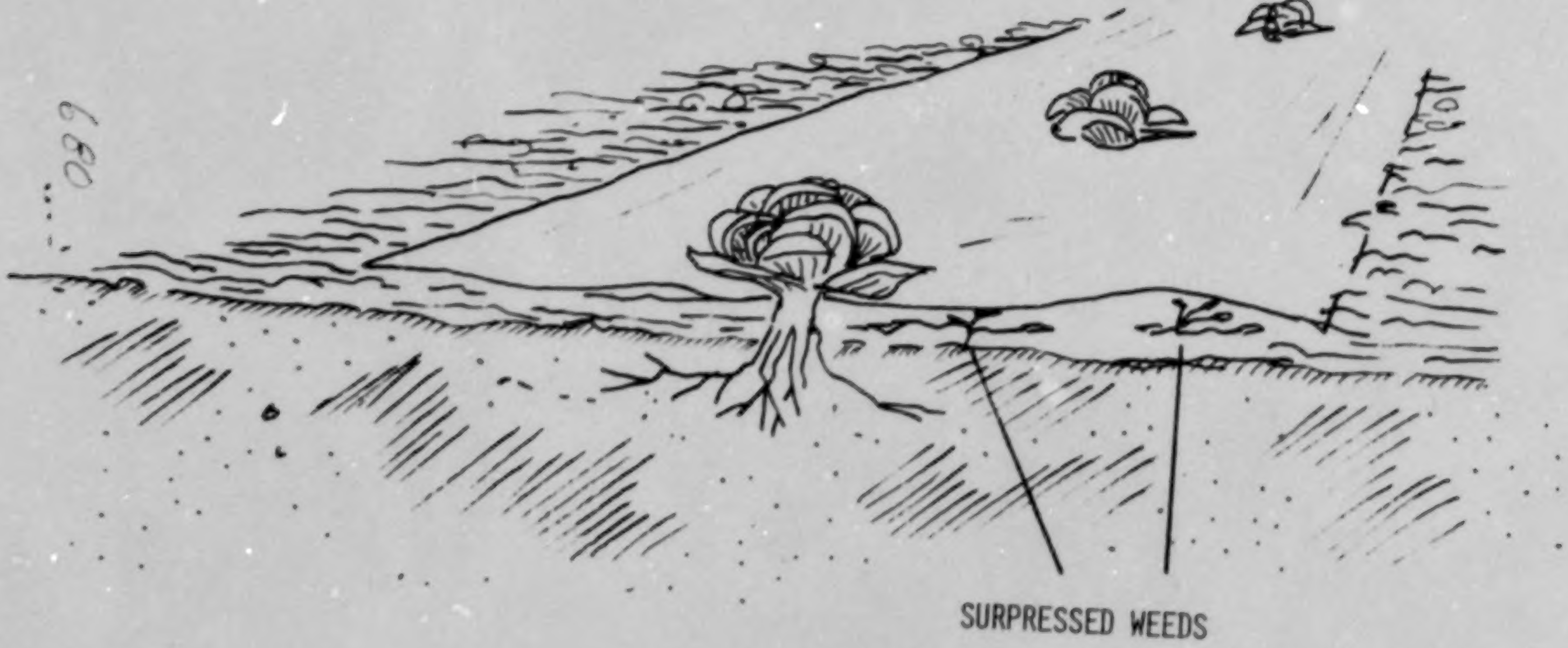
- SPADING FORK
- HOE
- RAKE
- TROWEL
- STAKES AND STRING

SEED FURROW IN RELATION TO SEED SIZE


1/4" - 1/2"
1/2" - 1"
1" - 1 1/2"

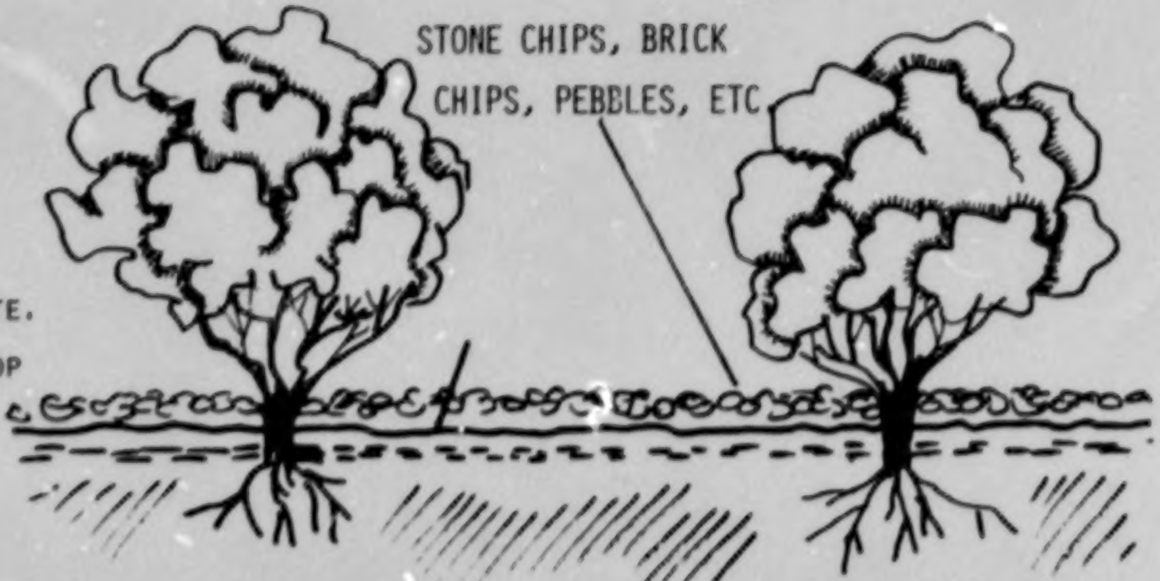
PLASTIC MULCH

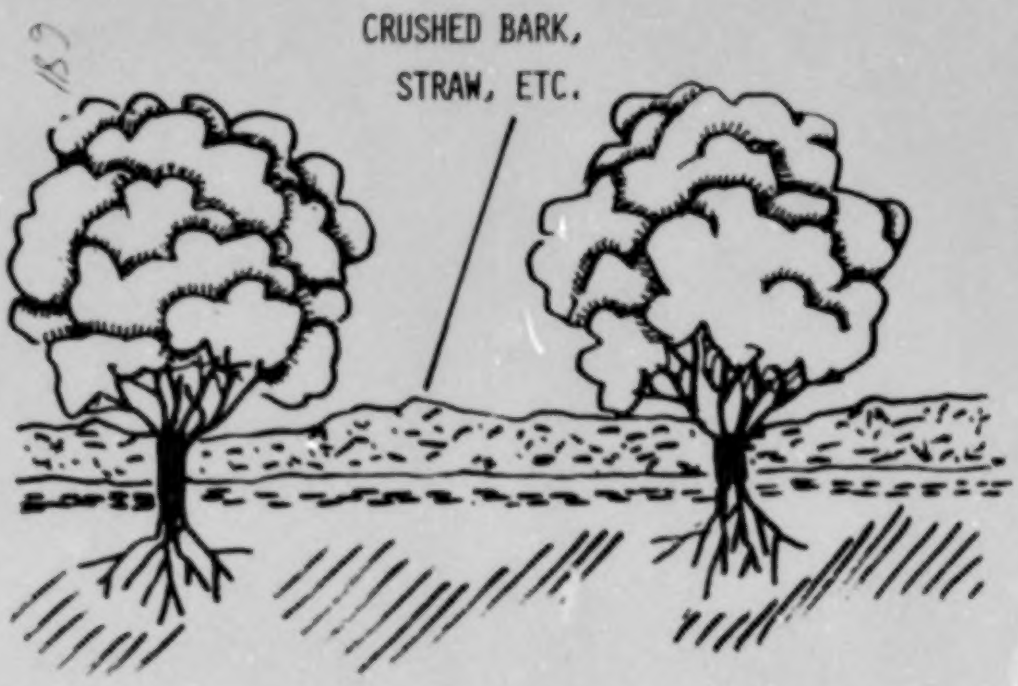
BLACK PLASTIC MULCHES IN THE VEGETABLE GARDEN SUPPRESS WEEDS AND CONSERVE MOISTURE.


SURPRESSED WEEDS

MULCH

CRUSHED STONE OR BRICKS AND PEBBLES MAY BE USED FOR THE EFFECT THEY CREATE. AS SHOWN HERE, THEY MAY BE USED ON TOP OF PLASTIC MULCH AROUND SHRUBS.


STONE CHIPS, BRICK CHIPS, PEBBLES, ETC


CRUSHED BARK, STRAW, ETC.

CRUSHED BARK, STRAW, AND OTHER SIMILAR MATERIALS MAKE GOOD MULCH IN LANDSCAPE PLANTINGS AND ADD VALUABLE ORGANIC MATTER TO THE SOIL. PLASTIC IS ORDINARILY NOT USED WITH ORGANIC MULCHES.

Adult Unit No. 21

HOME PATIO CONSTRUCTION

A Resource Unit For Adult Education Classes in Agriculture

Developed by
Monroe Harbage

Edited by
L. H. Newcomb

Department of Agricultural Education
College of Agriculture and Home Economics
The Ohio State University
Columbus, Ohio 43210

1975

PREFACE

THIS RESOURCE UNIT WAS DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U. S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN
ASSISTANT PROFESSOR

L. H. NEWCOMB
ASSISTANT PROFESSOR

683

TABLE OF CONTENTS

	PAGE
PREFACE	III
INTRODUCTION	1
STATE SITUATION	3
LOCAL SITUATION	3
OBJECTIVES	3
REFERENCES	3
NEEDED AV EQUIPMENT	4
ALTERNATIVE INTEREST APPROACHES	4
QUESTIONS TO BE ANSWERED	5
LEARNING ACTIVITIES	5
SUMMARIZE (NOTE TO TEACHER)	7
APPLICATION	7
APPENDIX A: CONTENT SUMMARY	8
APPENDIX B: INSTRUCTIONAL MATERIALS	18

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATIBLE TO THE LOCAL COMMUNITY.

HOME PATIO CONSTRUCTION

STATE SITUATION

MOST PEOPLE WOULD LIKE TO IMPROVE THEIR PATIO OR BACKYARD ENTERTAINMENT AREA. NO MATTER HOW GOOD THEIR AREA IS, A SIDEWALK OR PLANTER ADDITION MIGHT BE DESIRABLE.

LOCAL SITUATION

YOU CAN DETERMINE THE LOCAL SITUATION IN SEVERAL WAYS. EXAMPLES ARE:

1. VISIT COMMUNITY TO DETERMINE NEEDS.
2. POLE THE CLASS TO FIND OUT WHAT THEY CURRENTLY HAVE.
3. CATEGORIZE SUCH INFORMATION ON THE BOARD OR ON A TRANSPARENCY.

OBJECTIVES

THE LEARNER IS TO:

1. DESIGN STRUCTURES TO COMPLIMENT OR CONTRAST HIS EXISTING LANDSCAPE.
2. BUILD FORMS FOR POURING CONCRETE STRUCTURES.
3. INSTALL ELECTRIC FIXTURES (OPTIONAL).
4. PLACE UNDERLAYMENT OR FOOTERS.
5. LAY A PATIO, A SIDEWALK, OR A PORCH.
    A. CEMENT
    B. FLAGSTONE

REFERENCES

*BETTER HOMES AND GARDENS NEW GARDEN BOOK. NEW YORK: MEREDITH CORPORATION, 1968.

BUSH, J. AND BROWN, L. AMERICAN GARDEN BOOK. NEW YORK: CHARLES SCRIBNER'S SONS, 1967.

CROCKETT, JAMES U. LANDSCAPE GARDENING. TIME LIFE BOOKS, NEW YORK, 1971.

KRAMER, JACK. THE COMPLETE BOOK OF PATIO GARDENING. NEW YORK: G. P. PUTNAM'S SONS, 1970.

LANDSCAPING THE HOME GROUNDS. AGRICULTURAL EDUCATION SERVICE, DEPARTMENT OF AGRICULTURAL EDUCATION, THE OHIO STATE UNIVERSITY, 1969.

NELSON, WILLIAM R., JR. LANDSCAPING YOUR HOME. ILLINOIS: UNIVERSITY OF ILLINOIS, COLLEGE OF AGRICULTURE, COOPERATIVE EXTENSION SERVICE, CIRCULAR 858, 1971.

OLIVER, NUSS, AND BURGGRAF. LANDSCAPING THE HOME GROUNDS. PENNSYLVANIA: PENNSYLVANIA STATE UNIVERSITY, COLLEGE OF AGRICULTURE.

OUTDOOR LIVING: PLANNING AND CONSTRUCTION GUIDE. AMES, IOWA: MIDWEST PLAN SERVICE, IOWA STATE UNIVERSITY, 1968.

*READERS DIGEST PRACTICAL GUIDE TO HOME LANDSCAPING. NEW YORK: READERS DIGEST, 1972.

ROCKWELL, FRED. COMPLETE GUIDE TO SUCCESSFUL GARDENING. NEW YORK: DOUBLEDAY & COMPANY, 1965.

SCHUMARKER, K. N. GROUNDS MAINTENANCE AND CONSTRUCTION. ILLINOIS: UNIVERSITY OF ILLINOIS, COLLEGE OF AGRICULTURE.

*HIGH PRIORITY

NEEDED AV EQUIPMENT

OVERHEAD PROJECTOR, SLIDE PROJECTOR, AND VIEWING SCREEN.

ALTERNATIVE INTEREST APPROACHES

AFTER CLASS MEMBERS ARE ACQUAINTED AND ADMINISTRATIVE CHORES ARE TAKEN CARE OF, YOU CAN BEGIN THIS UNIT IN ONE OF SEVERAL WAYS.

ALTERNATIVE A. HAVE SLIDES OF DESIRABLE PATIOS FOR VIEWING. DISCUSS THE VALUE OF SUCH STRUCTURES, THEIR POTENTIAL USES, ETC.

ALTERNATIVE B. HAVE EXAMPLES OF BUILDING MATERIALS AVAILABLE FOR EXAMINATION AND COMPARISON.

ALTERNATIVE C. HAVE PICTURES OF CLASS MEMBERS' HOMES (BEFORE AND AFTER PICTURES WORK WELL) OR OF PREVIOUS CLASS MEMBERS' PRODUCTS.

ALTERNATIVE D. CREATE A FEELING OF INTEREST IN THE CLASS BY DRAWING FROM EXPERIENCES, PICTURES SHOWN, ETC. USE SLIDES OF PATIOS TO SHOW POTENTIAL PATIO DESIGNS AND USES.

688

QUESTIONS TO BE ANSWERED

1. WHAT ARE THE FAMILY NEEDS AND DESIRES?

2. WHAT MATERIALS CAN BE EASILY USED TO BUILD A HOME PATIO?

3. WHAT TYPE OF FOUNDATION IS REQUIRED?

4. HOW DO YOU LAY VARIOUS MATERIALS?

5. SHOULD THE AREA BE LIGHTED?

6. WHAT TYPES OF LIGHTING ARE AVAILABLE?

LEARNING ACTIVITIES

NOTE: THERE IS A LARGE SELECTION OF TRANSPARENCY MASTERS IN THE SECTION ENTITLED "INSTRUCTIONAL MATERIALS," WHICH YOU SHOULD USE TO ILLUSTRATE SOME OF THE POINTS YOU WILL DISCUSS IN THIS LESSON.

1. WHAT ARE THE FAMILY NEEDS AND DESIRES?

HAVE THE CLASS RECORD ON PAPER AN AGE PROFILE AND AN INTEREST PROFILE OF THEIR FAMILY. SEE TRANSPARENCY #1. DUPLICATE COPIES FOR CLASS. USE TRANSPARENCY TO FILL IN EXAMPLE ENTRIES.

DISCUSS SPACE REQUIREMENTS FOR SPECIAL ACTIVITIES AND HOBBIES OF FAMILY MEMBERS - 64 SQ. FT./FAMILY MEMBER (SEE CONTENT SUMMARY).

SHOW SLIDES OF PATIOS HAVING DIFFERENT SIZE AND USE TO GIVE THE CLASS AN IDEA OF WHAT IS AVAILABLE.

ONCE CLASS MEMBERS HAVE SOME IDEA OF THEIR FAMILY NEEDS, THEY NEED TO BEGIN SPECIFIC PLANNING FOR THEIR PROPERTY. HAVE EACH CLASS MEMBER PREPARE A SKETCH OF HIS PROPERTY INCLUDING EXISTING BUILDINGS AND TREES. USE TRANSPARENCY #2 AS AN EXAMPLE. (YOU MAY NEED TO HAVE CLASS PARTICIPANTS BRING IN PHOTOS OF THEIR PROPERTY SO YOU CAN BETTER HELP THEM.)

AFTER STUDENTS COMPLETE INITIAL SKETCH, HAVE THEM DRAW VARIOUS SHAPED PATIOS ON CONSTRUCTION PAPER, CUT THEM OUT, AND PLACE THEM ON THE PLAN TO ASSIST THEM IN DECIDING WHAT SHAPE PATIO THEY PREFER. USE TRANSPARENCY #3 TO SHOW SAMPLE SHAPES.

HAVE THE CLASS CONSIDER THE FOLLOWING QUESTIONS BEFORE DECIDING WHERE TO LOCATE THEIR PATIO. (NOTE: AS QUESTIONS ARE DISCUSSED, PROVIDE ILLUSTRATIONS TO POINT OUT POSSIBILITIES.)

- WHERE ARE YOU WILLING TO SPARE THE SPACE FOR A PATIO?

- DO YOU WANT YOUR PATIO HIDDEN FROM THE ROAD?

- ARE THERE ANY WORN PATHS? (NEED FOR WALKS.)

DISCUSS ENTRY AND EXIT PATTERNS FROM A HOME. BE SURE TO POINT OUT THE IMPLICATIONS OF TRAFFIC PATTERNS IN TERMS OF UTILITY OF THE STRUCTURE.

HAVE EACH STUDENT DRAW A PLAN (TO SCALE) FOR THE PATIO HE WANTS.

2. WHAT MATERIALS CAN BE EASILY USED TO BUILD A HOME PATIO?

ONCE STUDENTS DECIDE WHAT THEY WANT THEIR PATIO TO LOOK LIKE (NAMELY SHAPE AND SIZE), YOU NEED TO HAVE THEM CONSIDER FROM WHAT MATERIALS THEIR PATIO SHOULD BE CONSTRUCTED. THE FOLLOWING ITEMS SHOULD BE CONSIDERED IN MAKING THAT DECISION:

- FROM WHAT ARE NEARBY BUILDINGS MADE?

- FROM WHAT ARE NEARBY SIDEWALKS MADE?

- DO YOU WANT A CERTAIN STYLE (EARLY AMERICAN, MODERN, ETC.).

PUT A LIST OF MATERIALS ON THE BOARD WHICH CAN BE PURCHASED EASILY IN YOUR AREA. (WHERE POSSIBLE, HAVE SAMPLE AVAILABLE TO SHOW.)

COMPARE COSTS OF EACH TYPE OF BUILDING MATERIAL, USING A COMPARISON CHART SUCH AS TRANSPARENCY #4. HAVE FIGURES READY FROM LOCAL SUPPLIERS.

LIST SOME ADVANTAGES AND DISADVANTAGES OF THE VARIOUS BUILDING MATERIALS. (SEE CONTENT SUMMARY; MAKE A TRANSPARENCY OF TABLE 1.)

REMIND STUDENTS TO CONSIDER THE SHAPE DESIRED SINCE IT WILL AFFECT MATERIALS THAT CAN BE EASILY AND EFFECTIVELY USED.

3. WHAT TYPE OF FOUNDATION IS REQUIRED?

DISCUSS THE FOLLOWING FOUNDATIONS WHICH CAN BE USED:

- FIRM SOIL

- SAND

- CONCRETE

- CRUSHED STONE

BE SURE TO INDICATE THE DIFFICULTY OF USING MOST OF THE MATERIALS.

4. HOW DO YOU LAY VARIOUS MATERIALS?

REFER TO TABLE 1 IN THE CONTENT SUMMARY AND USE IT AS A TRANSPARENCY OR HANDOUT. USE TABLE 2 AS A HANDOUT.

HAVE STUDENTS PRACTICE LAYING SMALL SAMPLE AREAS USING THE VARIOUS MATERIALS.

- DEMONSTRATE HOW TO MIX CONCRETE.

- DEMONSTRATE HOW TO LAY BRICK IN YARD.

- DEMONSTRATE HOW TO LAY CONCRETE BLOCKS.

5. SHOULD THE AREA BE LIGHTED?

ITEMS STUDENTS NEED TO CONSIDER:

- AMOUNT OF EVENING ENTERTAINING ANTICIPATED

- LOCATION OF EXISTING LIGHTS

- EFFECT TO BE OBTAINED BY LIGHTING

6. WHAT TYPES OF LIGHTING ARE AVAILABLE?

DISCUSS THE POINTS PRESENTED IN THE CONTENT SUMMARY.

HAVE AVAILABLE A 12 VOLT KIT AND EXPLAIN ITS USES AND OPERATION TO THE CLASS.

SUMMARIZE (NOTE TO TEACHER)

HAVE SELECTED CLASS MEMBERS PRESENT THEIR PLAN INCLUDING MATERIALS NEEDED AND ESTIMATED COST. YOU NEED TO COORDINATE THE DISCUSSION, PULLING TOGETHER THE POINTS PREVIOUSLY DISCUSSED.

APPLICATION

HAVE CLASS MEMBERS PRACTICE THE FOLLOWING OPERATIONS BEFORE UNDERTAKING THEIR PROJECT (THIS SHOULD BE DONE AT SHCOOL UNDER YOUR SUPERVISION):

- LAYING BRICK ON SAND

- MIXING AND POURING CONCRETE

- BUILDING FORMS

- ASSEMBLING A 12 VOLT DECORATIVE LIGHTING KIT

APPENDIX A

CONTENT SUMMARY

1. PATIO LOCATION
2. PATIO SHAPES
3. MATERIALS WHICH MAY BE USED FOR PATIOS
4. OUTDOOR LIGHTING

692

HOME PATIO CONSTRUCTION

Patios today come in a large variety of shapes, forms and materials. They are usually adjoining the house or at least in close proximity to the outdoor living area.

Modern patios have a number of functions. They can serve as entryways, entertaining areas, relaxing areas, as well as for other purposes. Some people even consider a patio to be an additional room of the house.

Patio Location

A number of things need to be considered in deciding where to place a patio and how large it should be. A patio in the hot sun all day offers little pleasure to the homeowner. Likewise, a patio in full view of several neighbors has limited utility to the owner. Therefore, the potential patio builder needs to be careful in deciding upon location. He also needs to remember that while he may not be able to alter certain factors such as exposure to the sun, he can modify the effect of such factors by adding a roof, a screen, plants or other modifying effects.

Patio Shapes

Pleople vary in their preference for shape of patio. Some people prefer square or rectangular shapes while others lean toward circular, curving, elliptical or other shapes. Most paving materials can be used for any shape. However, where the homeowner is building the patio himself, he may not be able to use certain materials with some shapes. For example, he may find it difficult to use square concrete blocks for a curving patio.

Materials Which May Be Used For Patios

This discussion is restricted to the basic patio foundation or floor and does not consider walls, ceilings and other features. Any type of material can be used that suits the owner. However, the following materials are usually used:

Building Materials

Concrete
Brick

Slate
Gravel

WOOD
FLAGSTONE
CONCRETE BLOCKS
WOOD CHIPS
CRUSHED STONE
GRASS

IN SOME CASES, DEPENDING ON THE SKILL OF THE BUILDER, IT IS VERY DESIRABLE TO COMBINE MATERIALS IN CONSTRUCTING THE BASIC PATIO. FOR EXAMPLE, CONCRETE WITH EXPOSED WASHED AGGREGATE AND REDWOOD STRIPS LOOKS VERY NICE.

KRAMER[1] SUGGESTS THE FOLLOWING PROCEDURE FOR POURING THE SIMPLE CONCRETE PATIO:

> "OUTLINE THE PATIO BY SETTING OUT 2 BY 2-INCH STAKES WITH STRING STRETCHED BETWEEN THEM. DIG OUT AND REMOVE ALL TRASH FROM THE SOIL. SET EITHER PERMANENT OR TEMPORARY HEADER BOARDS IN PLACE. BE SURE TO SET HEADERS SO THE TOP SURFACE IS FLUSH WITH THE GRADE YOU WANT FOR THE CONCRETE. DRIVE ADDITIONAL STAKES AT 2-FOOT INTERVALS ALONG EACH SIDE OF THE PATIO, LINED UP CAREFULLY WITH THE GUIDE STRING. NAIL 10-INCH STRIPS OF 1/4-INCH PLYWOOD TO THE INSIDES OF THE STAKES TO ACT AS FORMS FOR THE CONCRETE. FORMS CAN BE BRUSHED WITH OIL TO MAKE IT EASIER TO REMOVE THEM AFTER THE CONCRETE IS POURED AND SET.
>
> WET THE SOIL A FEW TIMES THE DAY BEFORE THE CONCRETE IS TO BE POURED. THE NIGHT BEFORE, WET IT AGAIN SO IT WILL BE DAMP WHEN THE CONCRETE IS POURED. SOIL THAT IS DRY TAKES MOISTURE FROM THE CONCRETE AND WEAKENS IT.
>
> TO BUILD THE SMALL PATIO, RENT A PORTABLE MIXER - ASK FOR A HALF-BAG MACHINE - REVOLVED BY A GASOLINE MOTOR. PUT ONE CUBIC FOOT OF SAND AND HALF A SACK OF CEMENT INTO THE REVOLVING DRUM. ALLOW THE MATERIALS TO MIX. THEN ADD ONE CUBIC FOOT OF GRAVEL, AND LET THE DRUM REVOLVE FOR A FEW MINUTES OR UNTIL THE PEBBLES ARE UNIFORMLY COATED. NOW ADD TO THE DRUM ABOUT TWO GALLONS OF WATER AND LET THE MIXTURE TUMBLE FOR ABOUT FOUR MINUTES. POUR IT INTO A WHEELBARROW (RENTED FROM A HARDWARE STORE) AND DUMP THE MIXTURE INTO THE FORMS. MAKE PAVINGS 3 TO 4 INCHES THICK. SMOOTH OUT THE WET CONCRETE WITH A WOOD FLOAT TOOL. DIFFERENT FINISHES CAN BE APPLIED FOR VARIATION.
>
> THE SLICK OR HARD FINISH IS MADE BY MOVING A STEEL TROWEL OVER THE SURFACE WHEN IT IS PARTIALLY HARDENED. DO THE FIRST TROWELING LIGHTLY, JUST ENOUGH TO SMOOTH THE FLOAT TEXTURE. THEN TROWEL AGAIN WITH MORE PRESSURE. THIS FLOOR

---

[1] KRAMER, JACK. THE COMPLETE BOOK OF PATIO GARDENING. G.P. PUTNAM'S SONS, NEW YORK, 1970.

IS SLICK AND SOMEWHAT UNINTERESTING.

> THE WOOD-FLOAT METHOD LEAVES A FLOOR SMOOTH BUT NOT SHINY. IT IS DONE WITH THE MASON'S WOOD TROWEL (FLOAT).
>
> THE BROOM FINISH GIVES AN INTERESTING TEXTURE. IT IS MADE BY BRUSHING THE SLIGHTLY HARDENED CONCRETE WITH A PUSH BROOM."

CONCRETE BLOCKS ARE AVAILABLE COMMERCIALLY IN A VARIETY OF SHAPES, COLORS AND TEXTURES. THE CONCRETE BLOCK IS SIMPLE TO INSTALL AND THE JOB IS COMPLETED WITH A MINIMUM EXPENDITURE OF TIME.

LIKEWISE SLATES ARE VERY EASY TO USE.

PERHAPS BRICK IS USED AS MUCH FOR PATIOS AND WALKS AS OTHER BUILDING MATERIALS. BRICK MAY BE LAID ON SAND OR A MORE PERMANENT FOUNDATION. IT IS AVAILABLE IN MANY COLORS, SIZES AND TEXTURES. NOT ONLY ARE RECTANGULAR BRICKS AVAILABLE, BUT OTHERS ARE AS WELL. IT IS ESPECIALLY EASY TO LAY BRICK ON SAND, SINCE ERRORS ARE READILY REMEDIED. BEFORE LAYING A BRICK PATIO, MAKE SURE YOUR FOUNDATION AREA IS LEVEL. PROCEED TO LAY THE BRICK IN SMALL AREAS AT A TIME WITH A SAND BASE OF TWO TO THREE INCHES.

A NUMBER OF PATTERNS ARE AVAILABLE FOR LAYING BRICK PATIOS. ILLUSTRATIONS OF THE PATTERNS ARE FOUND ON TRANSPARENCIES #6 AND 7.

THE BRICKS (LAID ON SAND) NEED TO BE HELD BY SOME TYPE OF RATHER STRONG EDGING. SOME PEOPLE USE OLD RAILROAD TIES WHILE OTHERS USE MATERIALS SUCH AS WOODEN 2X4'S.

WOOD CAN BE USED VERY EFFECTIVELY FOR THE PATIO FLOOR AS WELL AS FOR BACKGROUND FEATURES, PLANT CONTAINERS, FURNITURE, DECKS, ETC. REDWOOD IS VERY WIDELY USED. HOWEVER, OTHER WOODS ARE ACCEPTABLE IF THEY ARE HIGH GRADE. YOUR LOCAL LUMBER SUPPLIER CAN PROVIDE YOU WITH HELPFUL INFORMATION. WOODEN BLOCKS, AS SHOWN ON TRANSPARENCY #28, ARE ALSO VERY ATTRACTIVE.

TABLE 1 OFFERS SOME ADVANTAGES AND DISADVANTAGES OF EACH OF THE MATERIALS PREVIOUSLY SUGGESTED AS WELL AS SOME TIPS ON CONSTRUCTION PROCEDURES.

OUTDOOR LIGHTING

OUTDOOR LIGHTING IS A VERY IMPORTANT ACCESSORY FOR A PATIO. THE EFFECT OF EVENING LIGHTING CAN BE QUITE DRAMATIC. ADDITIONAL LIGHTING, PROPERLY PLACED, CAN ENHANCE CERTAIN FEATURES AND SUBDUE OTHERS. IT CAN ALSO CHANGE MOODS AND THE GENERAL ATMOSPHERE OF THE EVENING.

THE BIGGEST CONSIDERATION IS WHERE TO PLACE THE LIGHTS. YOUR BASIC DECISION IS: WHAT DO YOU WANT LIT. IF YOU JUST WANT LIGHT FOR FUNCTIONAL PURPOSES, YOU CAN'T GO WRONG. HOWEVER, IF YOU WANT TO ACCENT FEATURES, YOUR DECISION BECOMES MORE IMPORTANT.

IF YOU WANT FULL LIGHT YOU WILL NEED TO WORK IN TO A 120 VOLT SYSTEM. HOWEVER, FOR ACCENT LIGHTING A 12 VOLT SYSTEM WILL WORK. THE 12 VOLT SYSTEM CAN BE USED EFFECTIVELY FOR LIGHTING, FLOWER BORDERS, WALKS OR PATHS, AND STEPS. A SEPARATE 12 VOLT SYSTEM MIGHT BE NEEDED FOR EACH AREA OF CONCERN, I.E. PATIO, BORDERS, WALKWAY. SUCH A DIVISION OF AREAS ALSO PROVIDES FOR INDEPENDENT LIGHTING OF THE VARIOUS AREAS AS NEEDED.

A VARIETY OF REFLECTIONS ARE AVAILABLE FROM GARDEN CENTERS AND OTHER SUPPLIERS.

FOR COMPLETE INFORMATION ON 12 VOLT SYSTEMS SEE LEAFLETS IN COMMERCIALLY AVAILABLE KITS. IF YOUR CLASS MEMBERS ARE INTERESTED IN INSTALLING 120 VOLT LIGHTING, HAVE THEM DECIDE WHERE THEY WANT THE OUTLET(S) AND THEN CONTACT AN ELECTRICIAN.

TABLE 1

Comparison of the More Popular Patio Building Materials

Material	Advantages	Disadvantages	Construction Tips
Concrete	Fits all forms. Can have a wide range of various textures. Can be colored. Long lasting.	If not mixed correctly it will crack. Heavy to work with. Need certain equipment to handle it. Hard work. Hard to repair.	1. Remove all vegetation. 2. Subgrade must be level. 3. Use sand or crushed stone subgrade. 4. Dampen subgrade before pouring concrete. 5. Spread concrete as soon as possible after it is mixed. 6. Allow water that rises to top to evaporate and the concrete to start to stiffen before: rounding edges, and cutting partial joints to encourage proper cracking. (See T-25) 7. Float 8. Trowel 9. Cure (keep surface dry for five days or so, then remove forms)

MATERIAL	ADVANTAGES	DISADVANTAGES	CONSTRUCTION TIPS
BRICK	MANY COLORS. CONTRASTING TEXTURE. SAFE SURFACE. EASY TO USE.	DO NOT CLEAN WELL. FREEZING AND THAWING CAN CAUSE DAMAGE. VEGETATION IS A PROBLEM AT JOINTS. EXPENSIVE.	1. THE AMATEUR SHOULD USE A SAND BASE. 2. GRADE AREA WHERE PATIO IS TO BE LOCATED, THEN PLACE A TWO-INCH LAYER OF SAND. 3. SET UP HEADER BOARDS TO DESIRED FINISHED GRADE. USE DIVIDERS FOR LARGE AREAS. 4. LEVEL SAND, PLACE BRICKS IN DESIRED PATTERN - KEEP LEVEL. 5. SPREAD SAND ON LAID BRICKS AND SWEEP INTO JOINTS.
WOOD (REDWOOD, CYPRESS, AND CEDAR ARE USED MOST OFTEN.	PLEASING TEXTURE AND COLOR. IF TREATED PROPERLY, LASTS FOR YEARS. OFFERS VARIETY.	SUBJECT TO DECAY. SLIPPERY WHEN WET.	1. PLACE PIECES ON STABLE SOIL FOUNDATION OR ON A BASE OF SAND. USE FORMS TO KEEP STRAIGHT. 2. APPLY A PRESERVATIVE TO ALL SURFACES OF ALL WOODS USED.

Material	Advantages	Disadvantages	Construction Tips
Flagstone	Unlimited designs and patterns are possible. Is not affected adversely by weather.	Very expensive. Need to design carefully. Slippery when wet.	1. Lay carefully to avoid poor color combinations and disturbing patterns. 2. Have a trial design before committing yourself to a final design. 3. Allow for joint space. 4. Lay in soil or sand. Soil -Dig out to the shape of the piece to be laid. This is good for walks or small areas but NOT for most patios. Sand -Use 2-inch bed on stable soil. -Put soil in joints and plant grass in joints.

TABLE 2

Suggested Concrete Mixes for Patios[1]

	Maximum Size Aggreg.	Gallons of water for each sack of cement[1]			Suggested mixture for 1-sack trial batches[2]			Ready Mix sacks
		Dump Sand [3]	Wet (Av.) Sand[4]	Very Wet Sand[5]	Cement[6] Sacks cu.ft.	Aggregates[7] Fine, cu.ft.	Coarse, cu.ft.	Cement Per Yard[8]
6-gallon mix	1"	5 1/2	5	4 1/2	1	2 1/4	3	6 1/4
	1 1/2"	5 1/2	5	4 1/2	1	2 1/2	3 1/2	6

---

[1] Outdoor Living: Planning and Construction Guide. Ames, Iowa: Midwest Plan Service, Iowa State University, 1968.

TABLE 2 (CONT.)

[1] INCREASING THE PROPORTION OF WATER TO CEMENT REDUCES THE STRENGTH AND DURABILITY OF CONCRETE. ADJUST THE PROPORTIONS OF TRIAL BATCHES WITHOUT CHANGING THE WATER-CEMENT RATIO. REDUCE GRAVEL TO IMPROVE SMOOTHNESS; REDUCE BOTH SAND AND GRAVEL TO REDUCE STIFFNESS.

[2] PROPORTIONS WILL VARY SLIGHTLY DEPENDING ON GRADATION OF AGGREGATES.

[3] DAMP SAND WILL FALL APART AFTER BEING SQUEEZED IN THE PALM OF THE HAND.

[4] WET SAND WILL BALL IN THE HAND WHEN SQUEEZED, BUT LEAVES NO MOISTURE ON THE PALM.

[5] VERY WET SAND HAS BEEN RECENTLY RAINED ON OR PUMPED.

[6] USE AIR-ENTRAINED PORTLAND CEMENT IN CONCRETE FOR OUTDOOR USE. IT VIRTUALLY ELIMINATES SCALING DUE TO FREEZING, THAWING, AND SALT ACTION. IT IS MORE WORKABLE AND COHESIVE, REDUCES SEGREGATION AND BLEEDING, AND HAS IMPROVED SULFATE RESISTANCE. SINCE IT IS MORE WORKABLE, IT REQUIRES LESS MIXING WATER - AN ADDED BENEFIT.

[7] AGGREGATES MUST BE CLEAN AND FREE OF DIRT, CLAY, COAL, ORGANIC MATTER, ETC. THEY MUST BE DURABLE, HARD, AND HAVE FEW LONG SLIVERS. FINE AGGREGATE, USUALLY SAND, SHOULD HAVE PARTICLES UP TO 1/4" IN SIZE. COARSE AGGREGATES, COMMONLY GRAVEL OR CRUSHED ROCK, ARE PIECES ABOVE 1/4".

[8] MEDIUM CONSISTENCY (3" SLUMP). ORDER AIR-ENTRAINED CONCRETE FOR OUTDOOR USE.

APPENDIX B

Instructional Materials

Transparencies

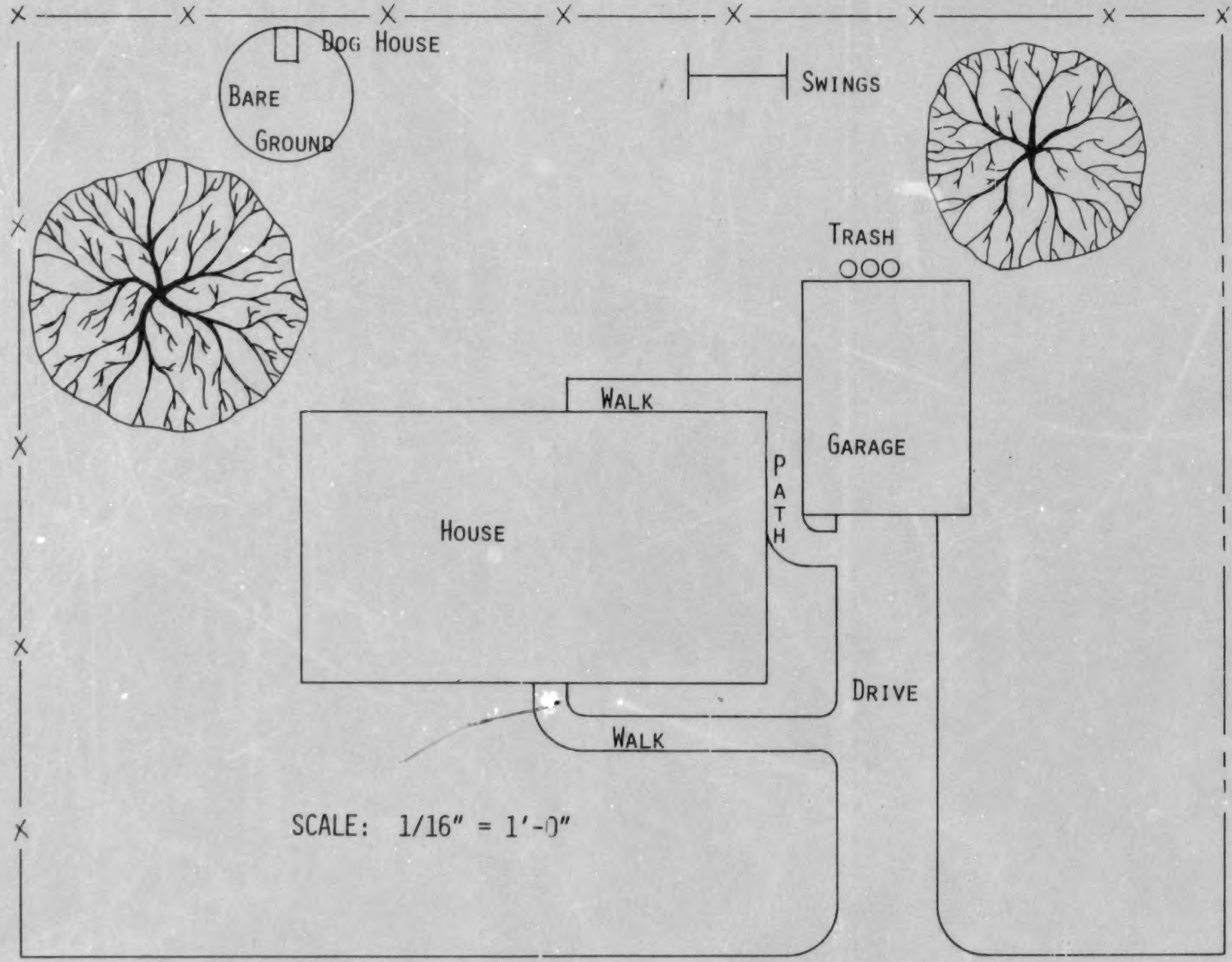
T-1	Family Needs
T-2	Sample Home Landscape
T-3	Illustrate Different Patios
T-4	Comparative Costs of Building Materials
T-5	Right Angle Corner
T-6	Basket-weave Walk and Patio
T-7	Basket-weave and Herringbone Walk and Patio
T-8	Curved Form
T-9	Slope of the Form
T-10	Linear Form
T-11	Blocking-off Walks and Patios
T-12	Form for Square Stones
T-13	Make Your Own "Flagstones"
T-14	Make Round Forms Out of Metal
T-15	Leveling a Sand Base
T-16	Brick or Flagstone Sub-base
T-17	Precast Squares
T-18	Finishing Stepping Stones
T-19	Screed Board
T-20	Texture the Surface by Brushing with a Steel Brush

T-21	A Broom Gives Texture
T-22	Floating with a Wood Trowel
T-23	Floating Concrete
T-24	Constructing Stepping-stones
T-25	Cutting Flagstone
T-26	Exposed Washed Aggregate Accompanied by a Planter with Smooth Stones
T-27	Irregular Flagstone with Sod Joints
T-28	Log Cross-sections for Surface
T-29	Finishing Concrete with a Brushed Texture
T-30	Removing Excess Sand After Filling Joints
T-31	Concrete Steps with Exposed Aggregate and 12 Volt Lighting
T-32	Using a Trowel to Fill Flagstone Joints with Mortar

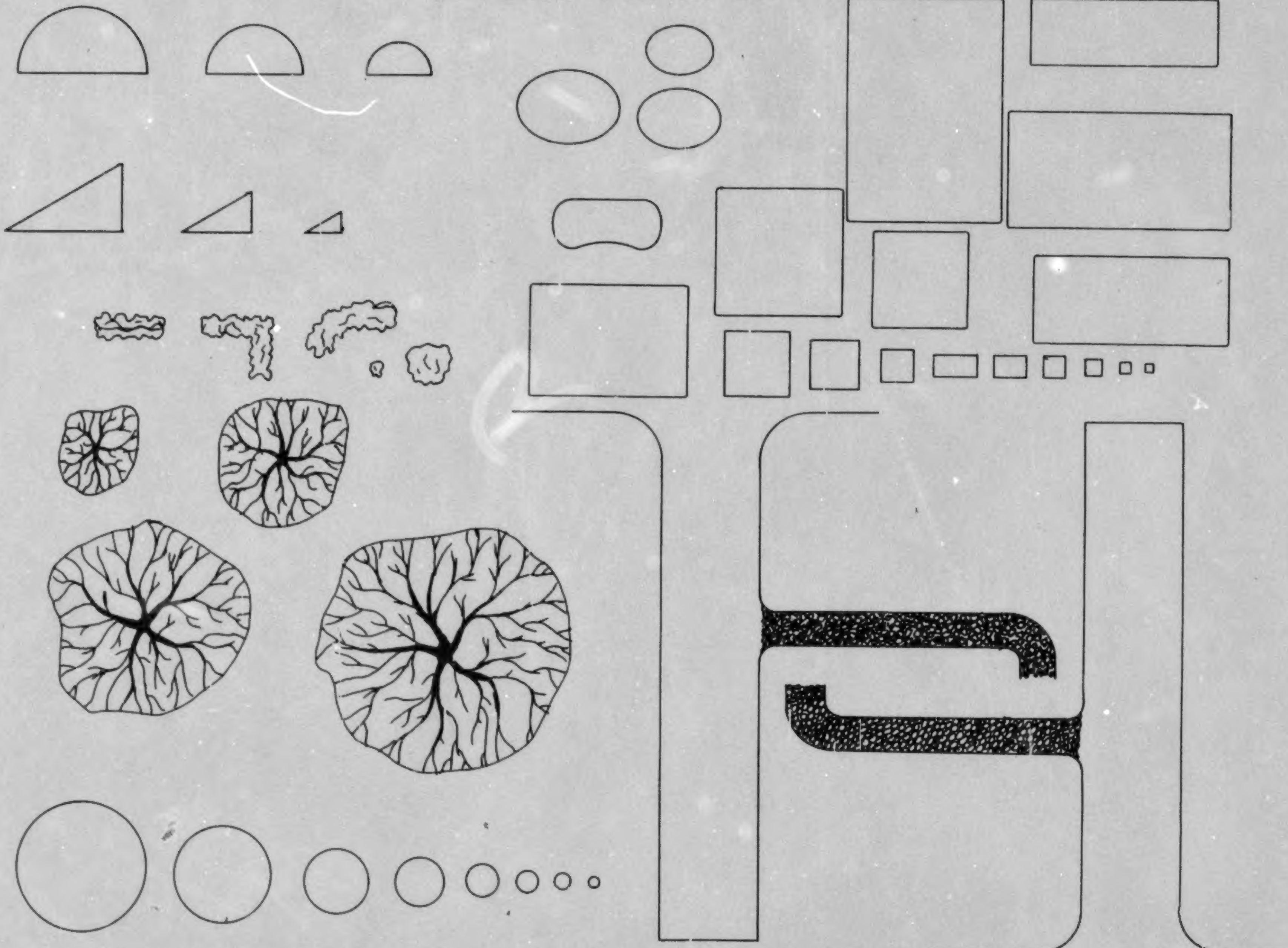
FAMILY NEEDS

Names of Family	Age	Interests (include Parties, Games, Extent of Entertaining	Toys, etc. Which Might Be Around Patio

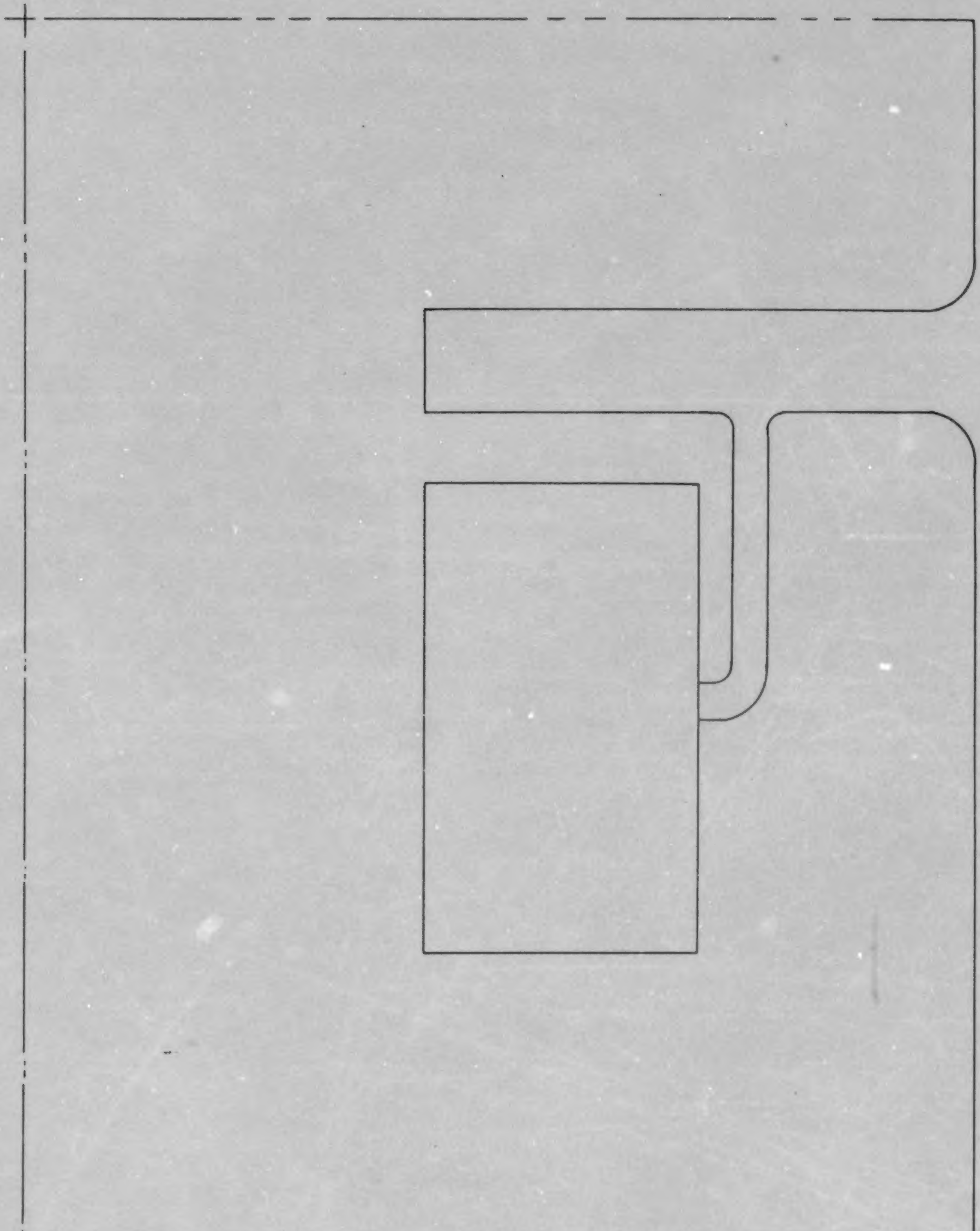
SAMPLE HOME LANDSCAPE


DOG HOUSE
BARE GROUND
SWINGS
TRASH
GARAGE
WALK
PATH
HOUSE
DRIVE
WALK
SCALE: 1/16" = 1'-0"

TEMPLATES TO BE CUT OUT

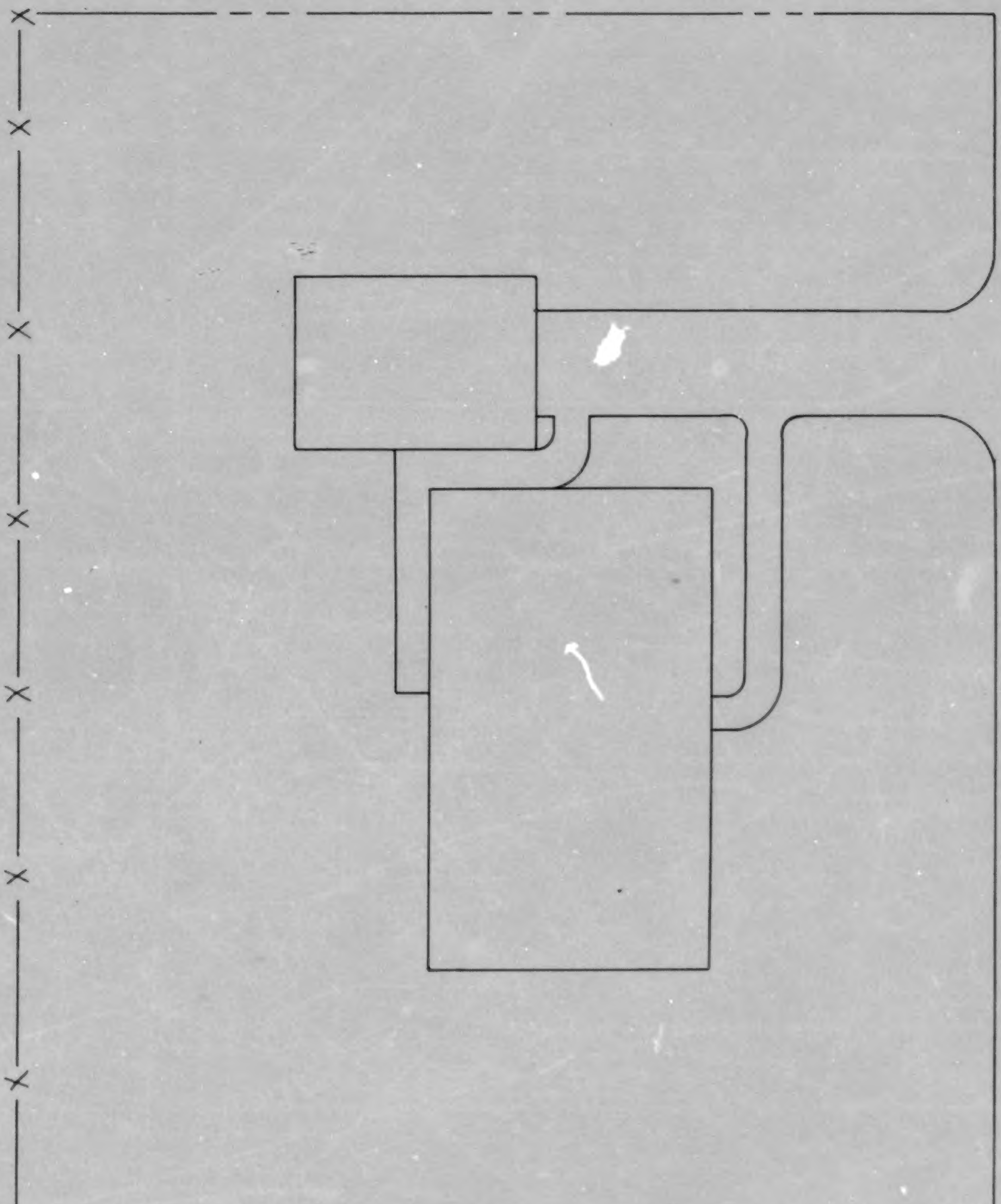


PLANNING THE LANDSCAPE



T-3

PLANNING THE LANDSCAPE



T-3

708

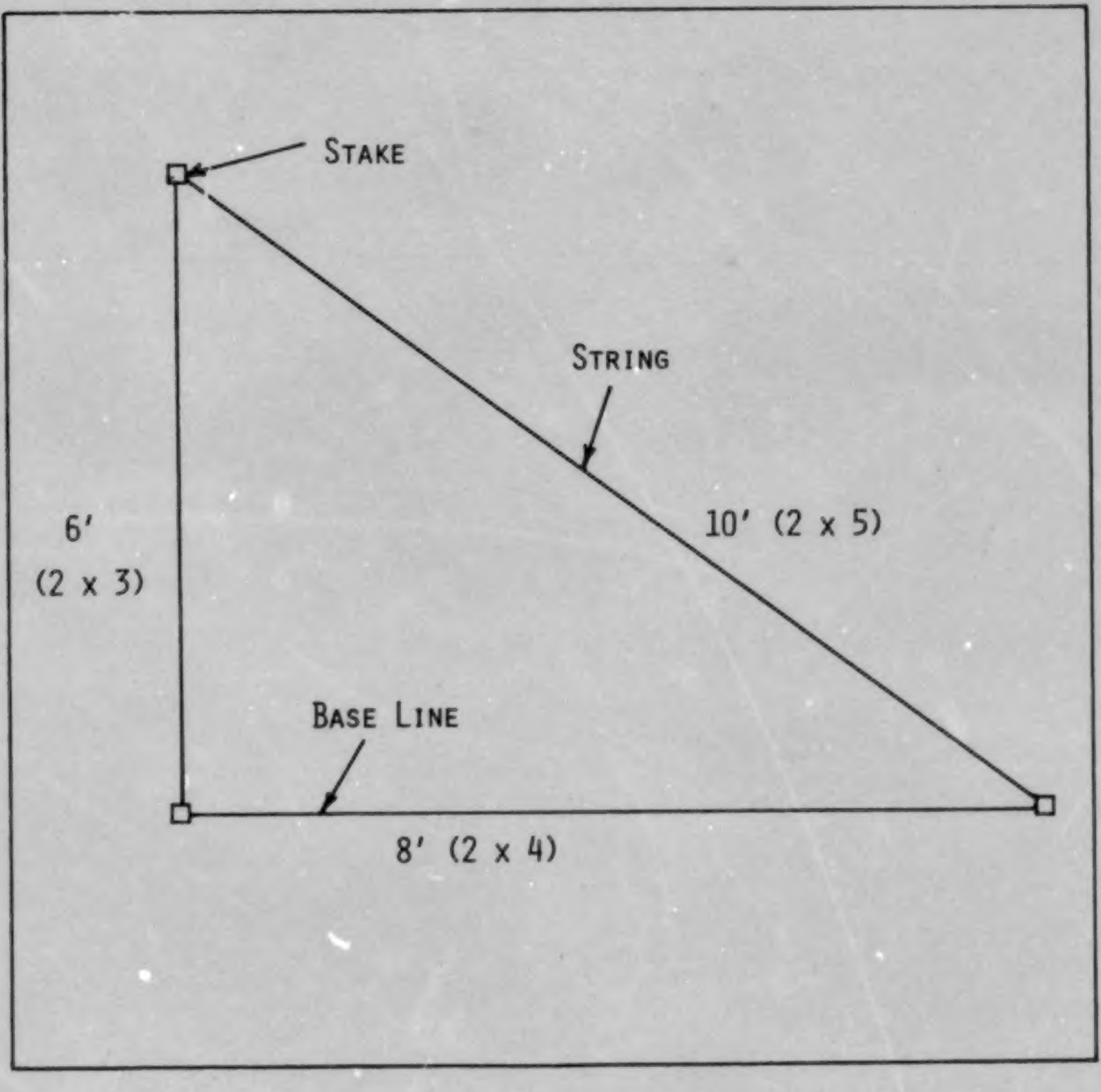
COMPARATIVE COSTS OF BUILDING MATERIALS

MATERIAL	UNIT (EX. SQ.FT.)	PRICE/UNIT

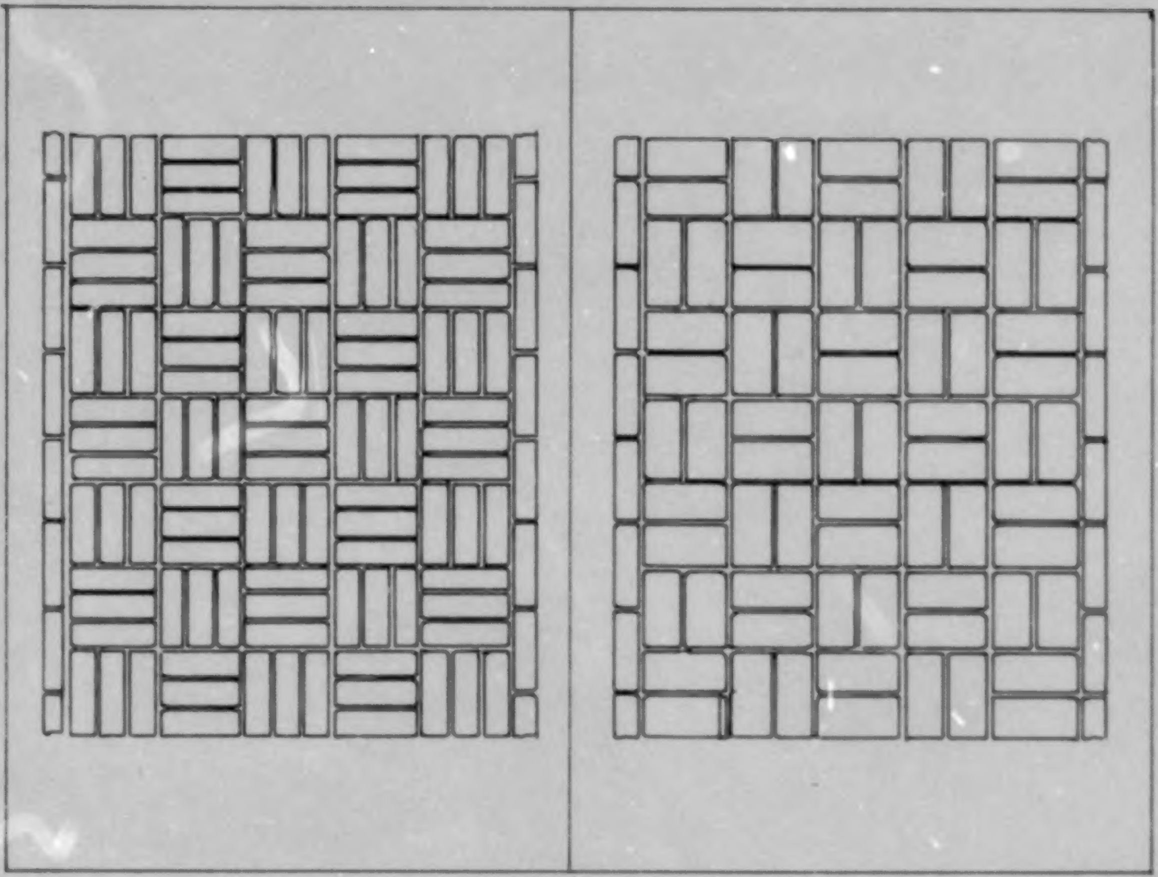
709

T-4

RIGHT ANGLE CORNER


STAKE
STRING
10' (2 x 5)
6'
(2 x 3)
BASE LINE
8' (2 x 4)

BASKET-WEAVE WALK AND PATIO



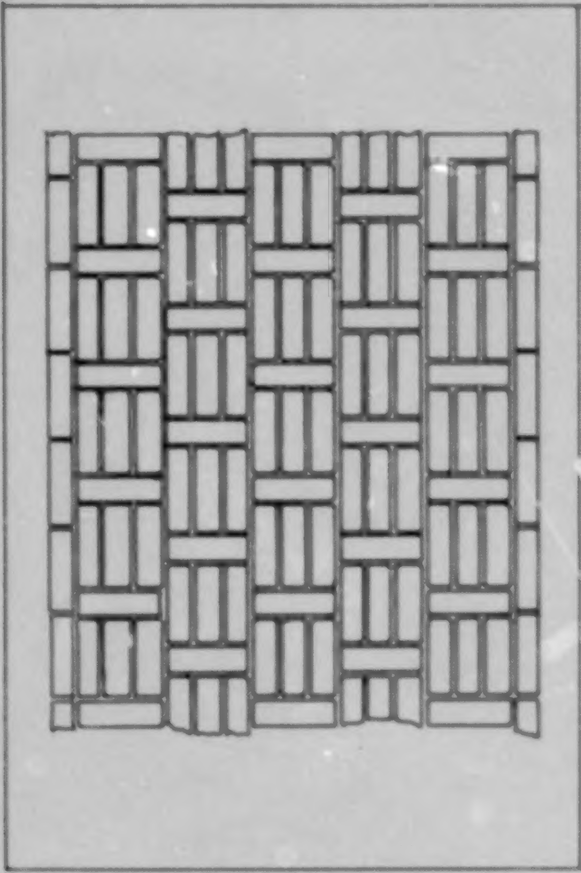
Basket-weave edge

This three-brick basket-weave pattern set on edge is a popular design for paving terraces.

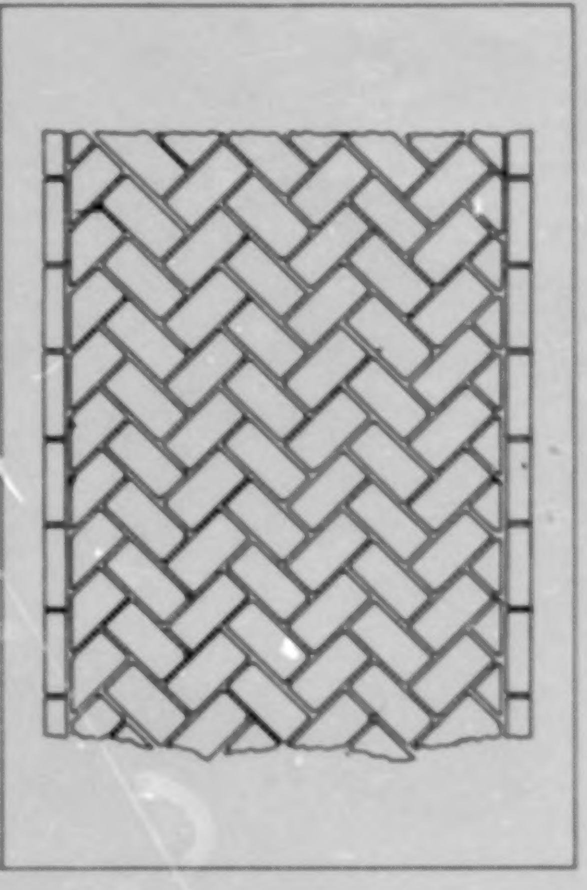
Basket-weave flat

Basket-weave flat is just as attractive as on edge design at left and requires much less brick.

BASKET-WEAVE AND HERRINGBONE WALK AND PATIO



BASKET-WEAVE VARIATION

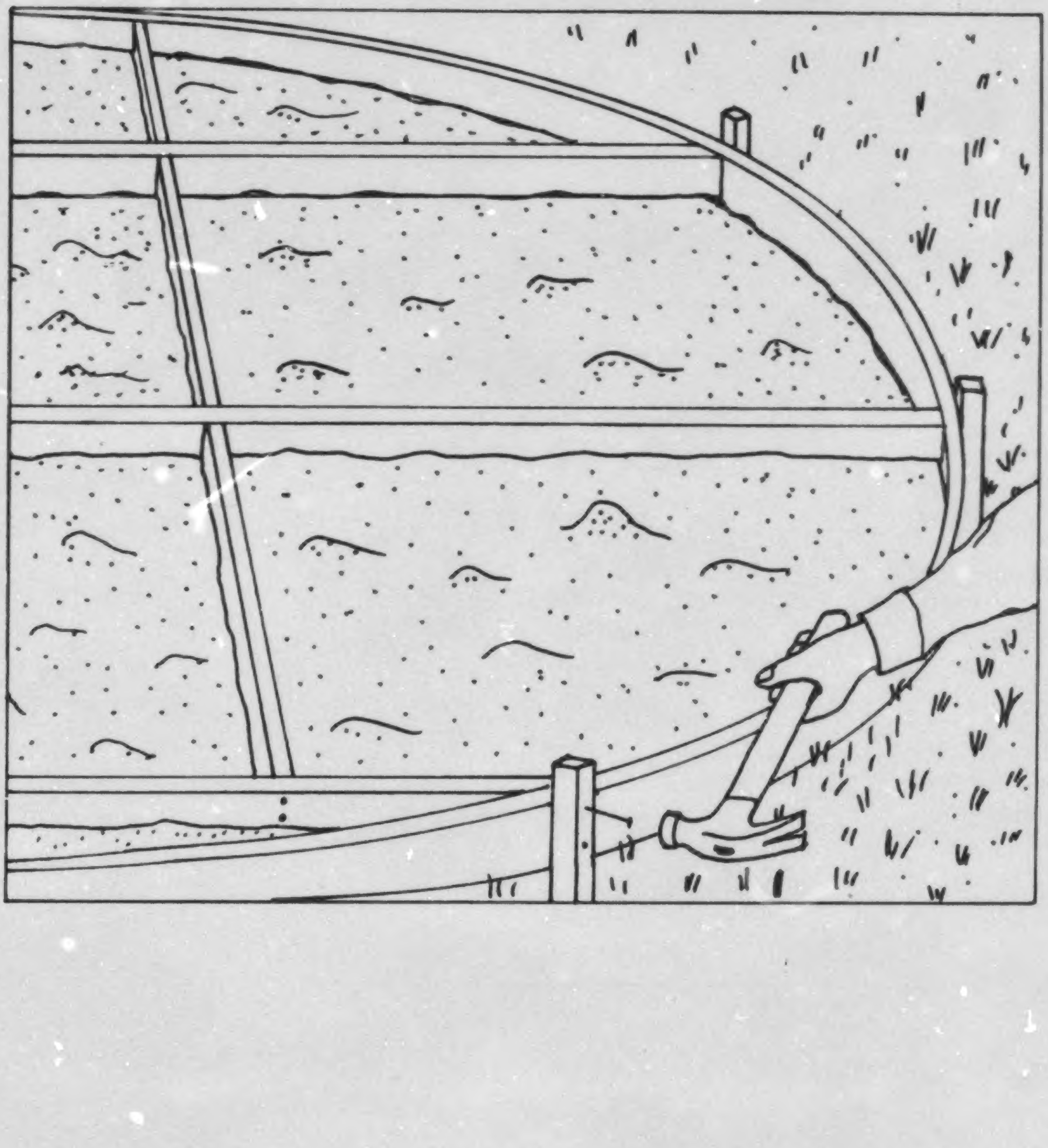


HERRINGBONE

VARIATION OF THE BASKET-WEAVE ON EDGE IS SHOWN AT LOWER LEFT. IT'S SLIGHTLY HARDER TO LAY.

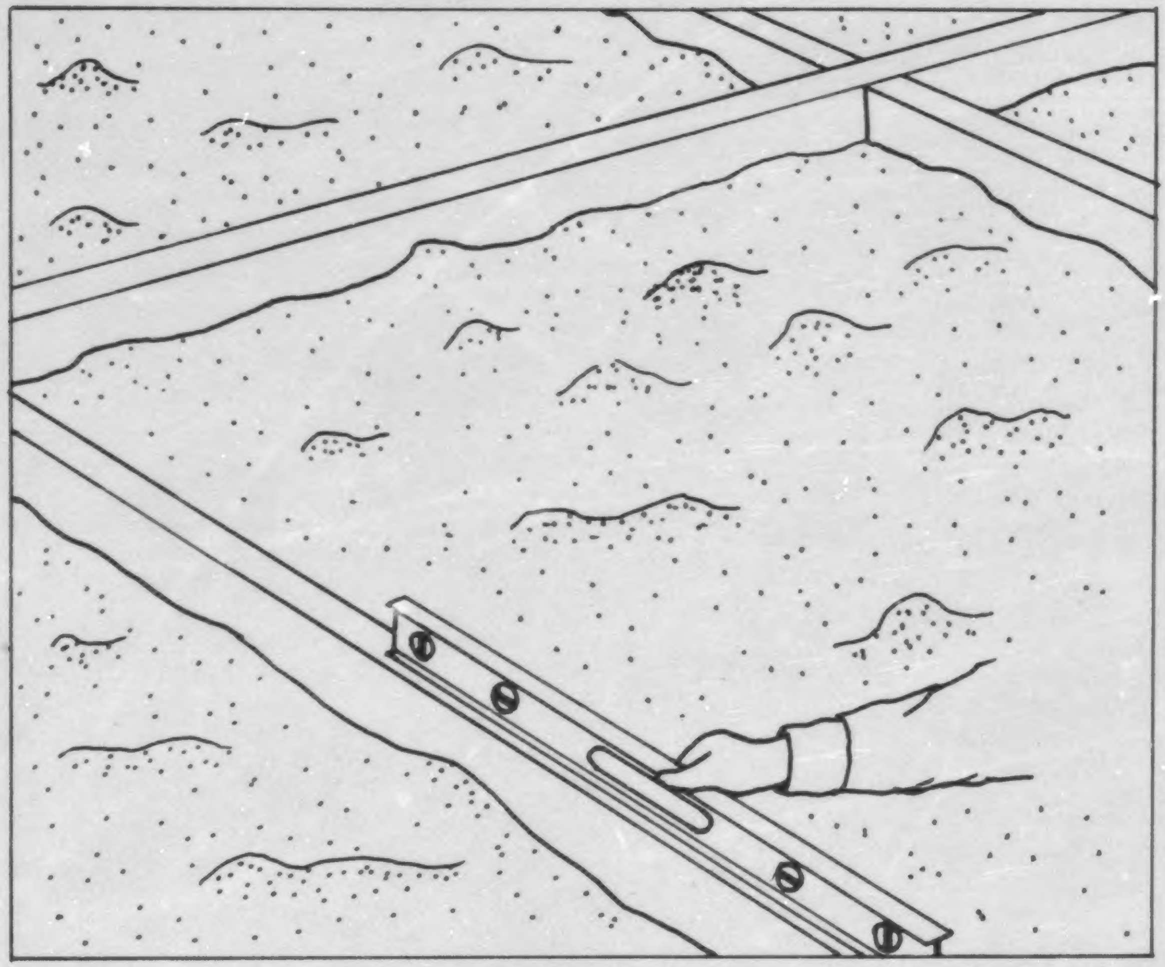
HERRINGBONE FLAT PATTERN IS PERHAPS THE HARDEST OF ALL TO LAY AND KEEP BRICKS ALIGNED.

CURVED FORM



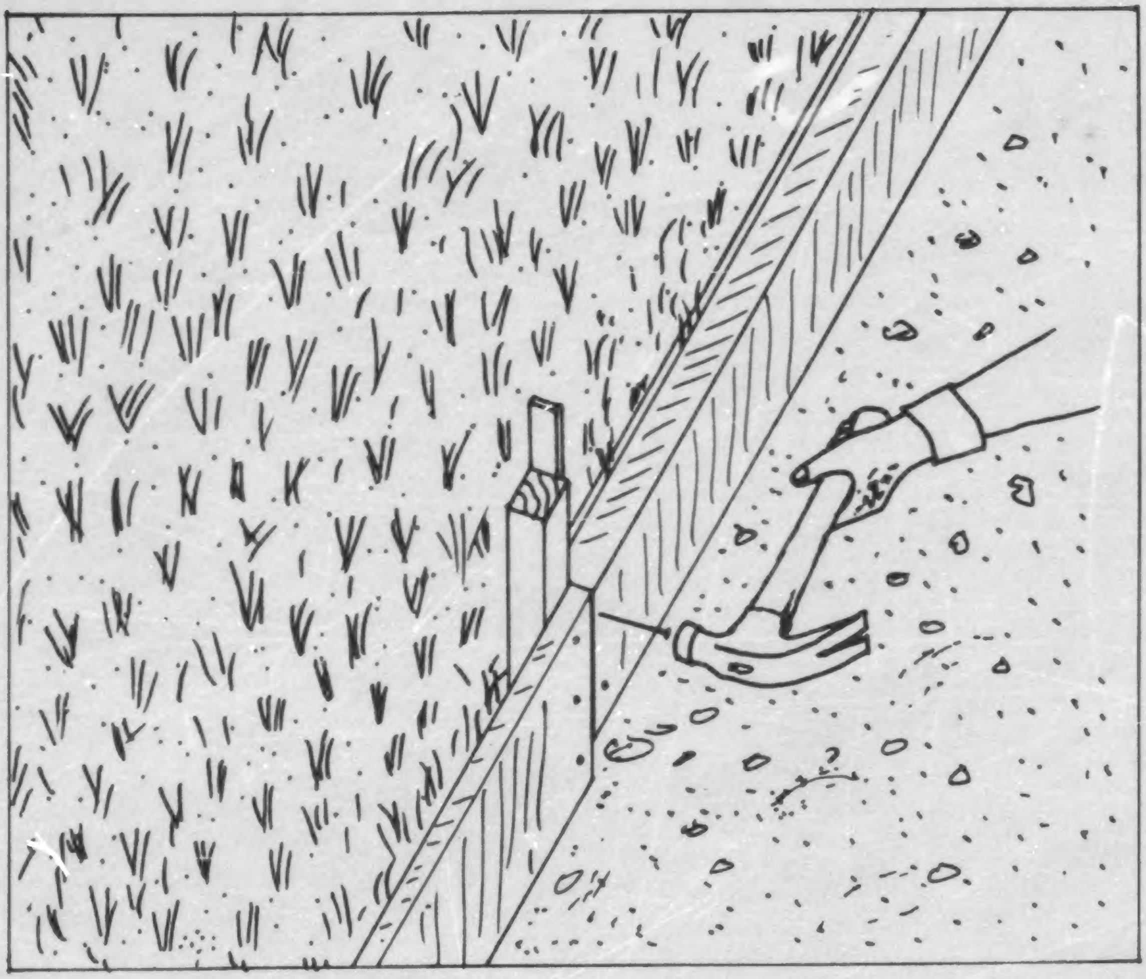
T-8

SLOPE OF THE FORM

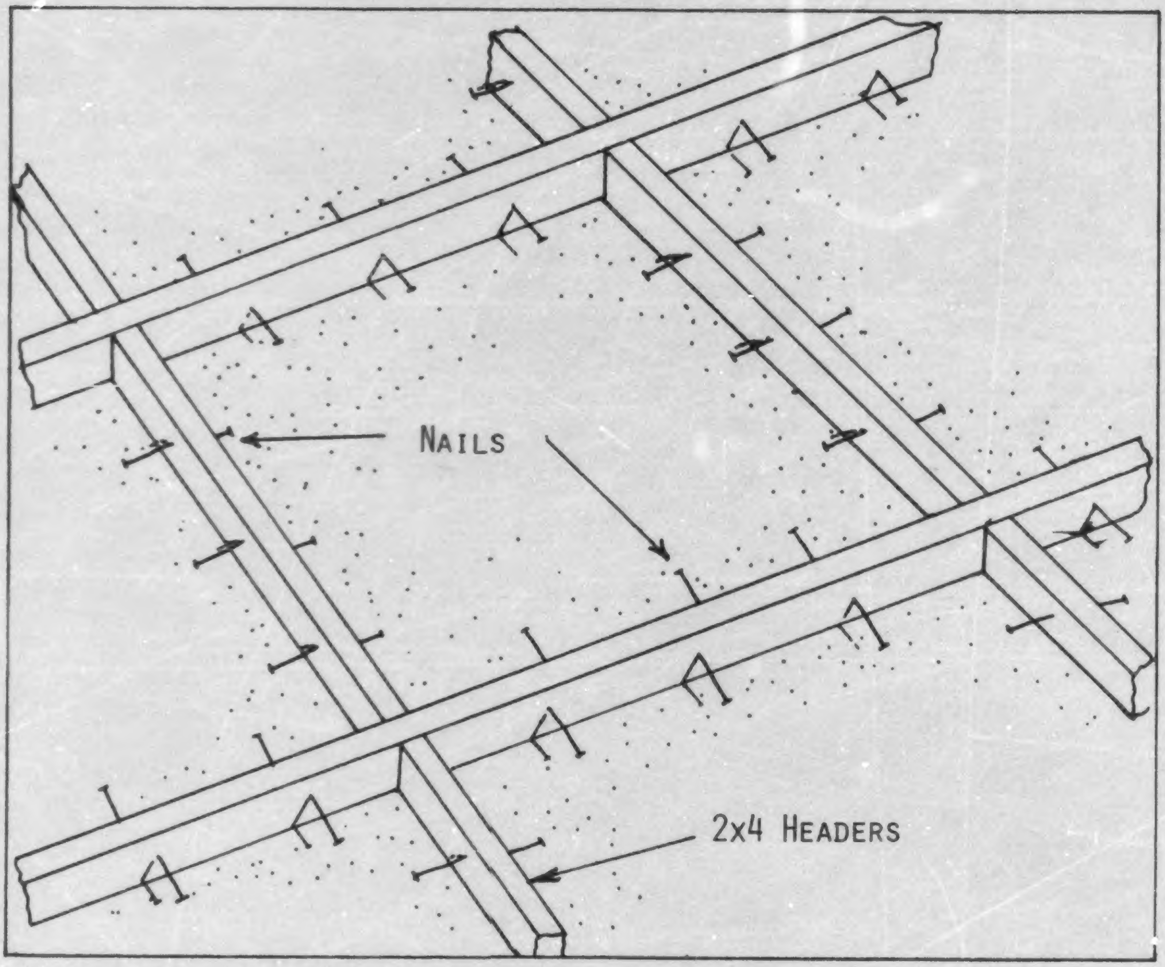


T-9

LINEAR FORM

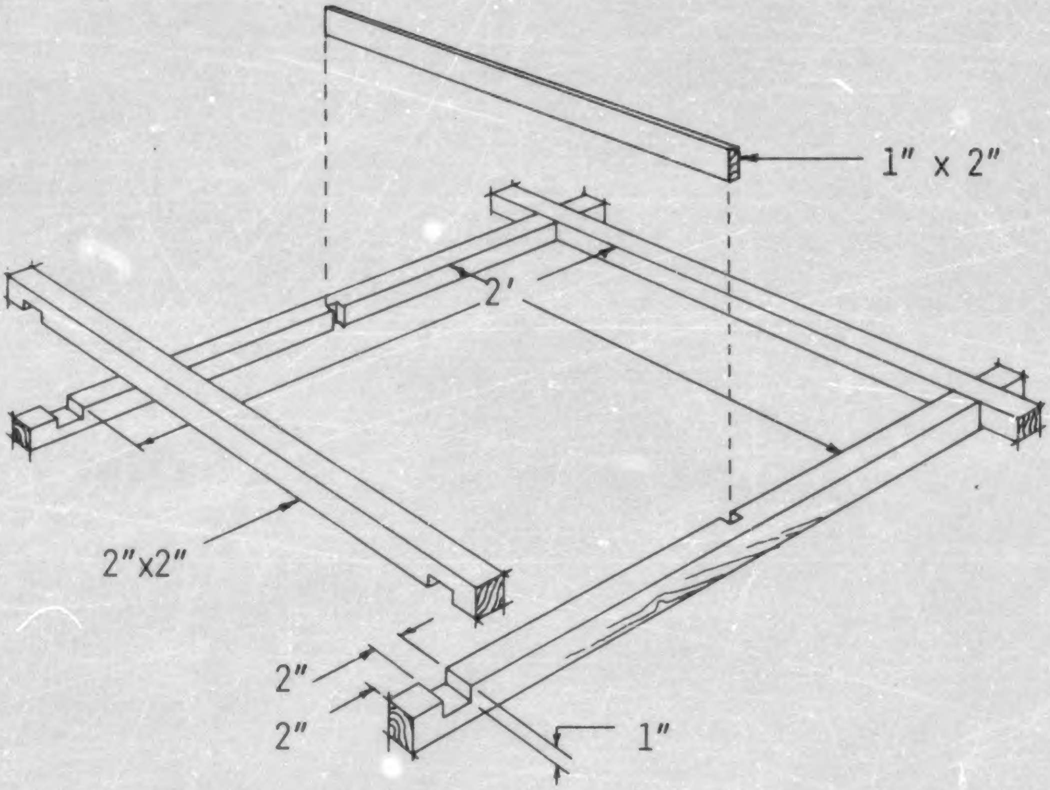


BLOCKING-OFF WALKS AND PATIOS


NAILS
2x4 HEADERS

T-11

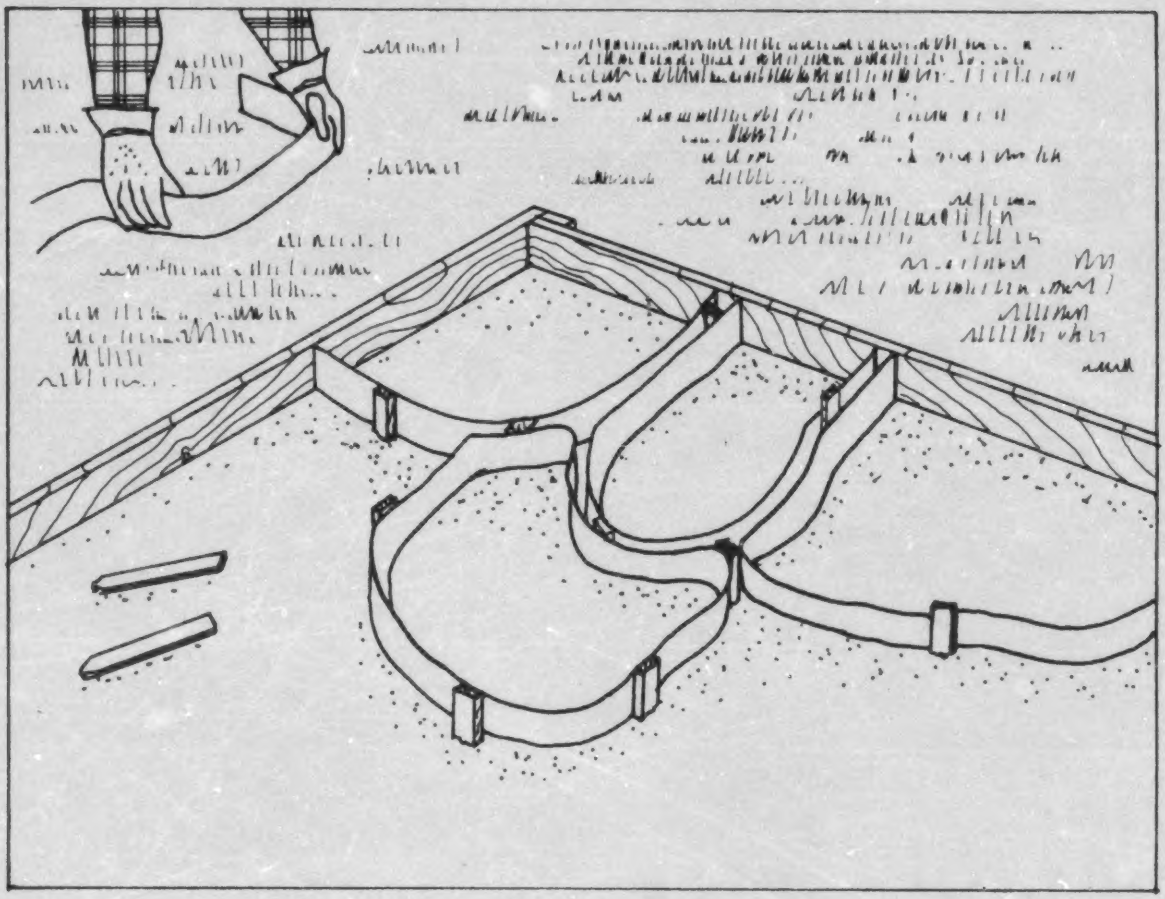
FORM FOR SQUARE STONES



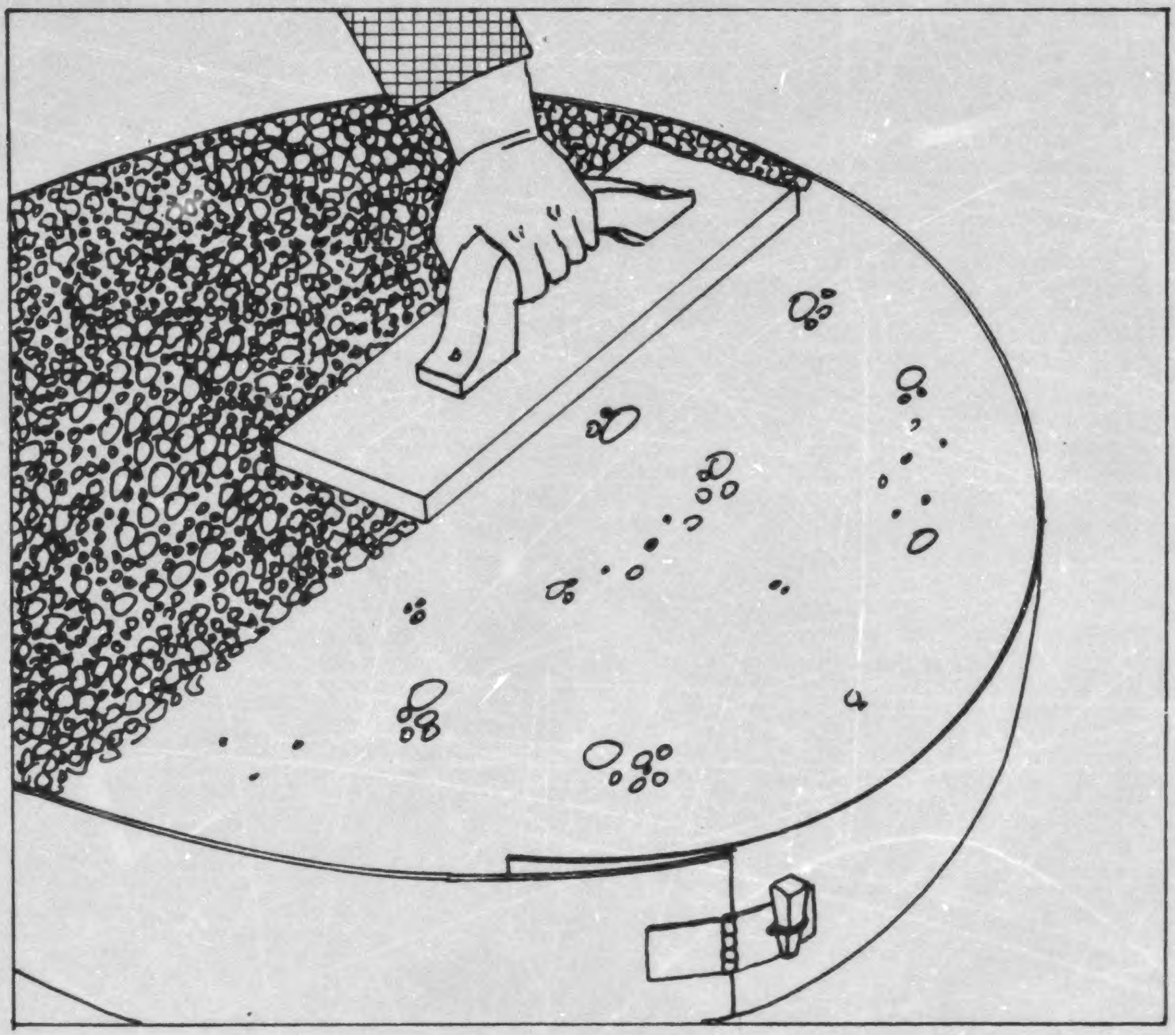
1" x 2"
2'
2"x2"
2"
2"
1"

T-12

MAKE YOUR OWN "FLAGSTONES"

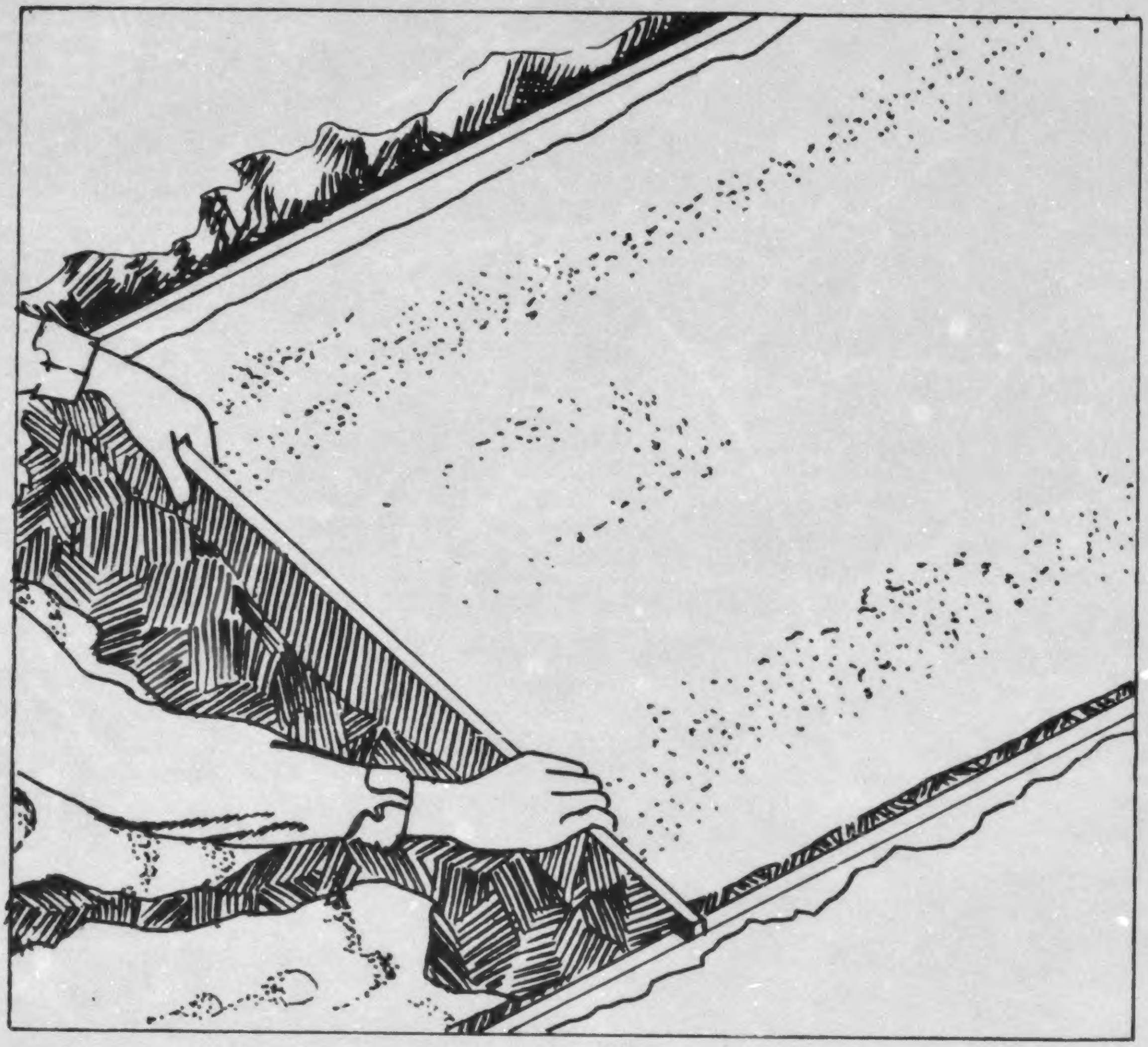


MAKE ROUND FORMS OUT OF METAL



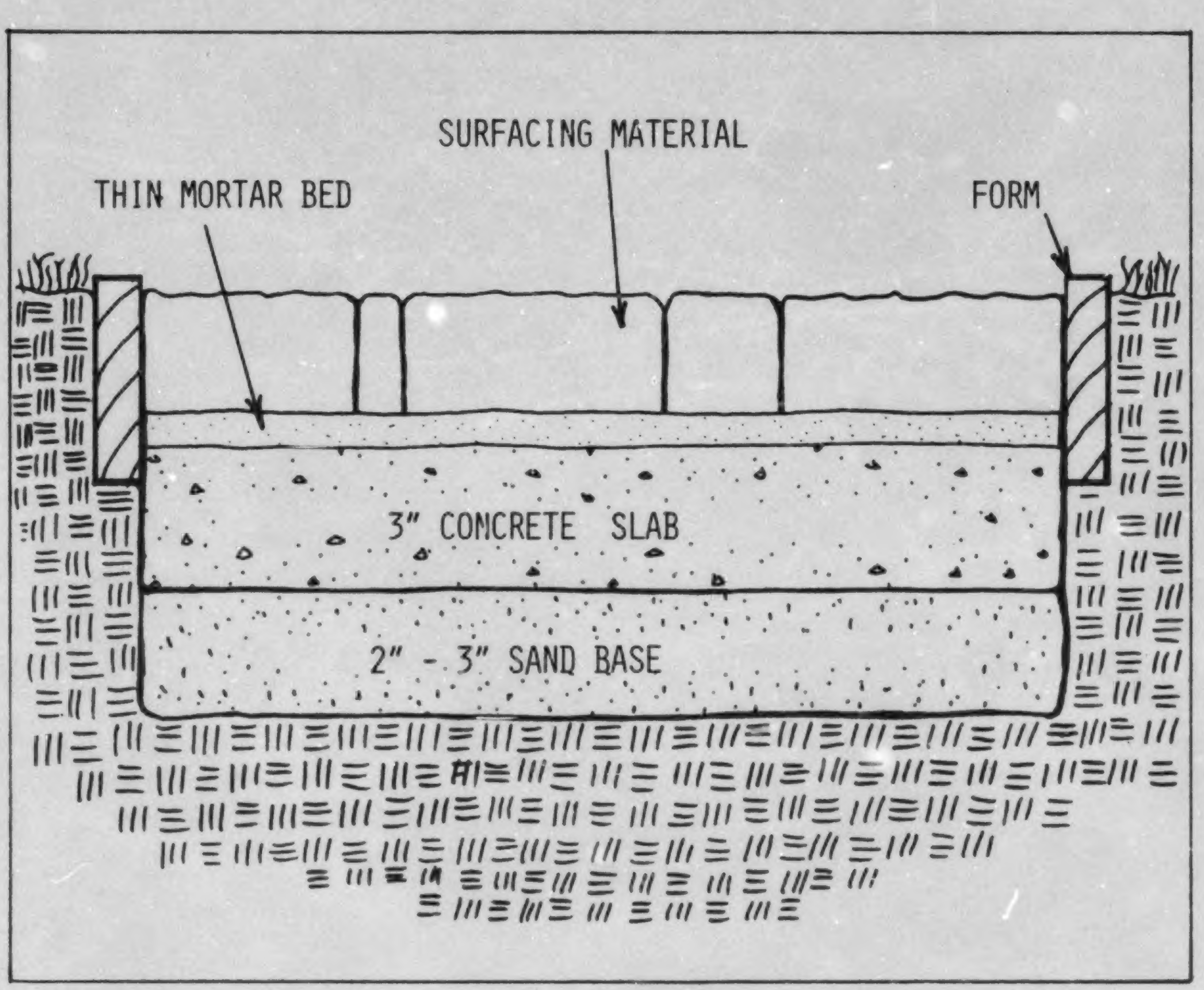
719

LEVELING A SAND BASE

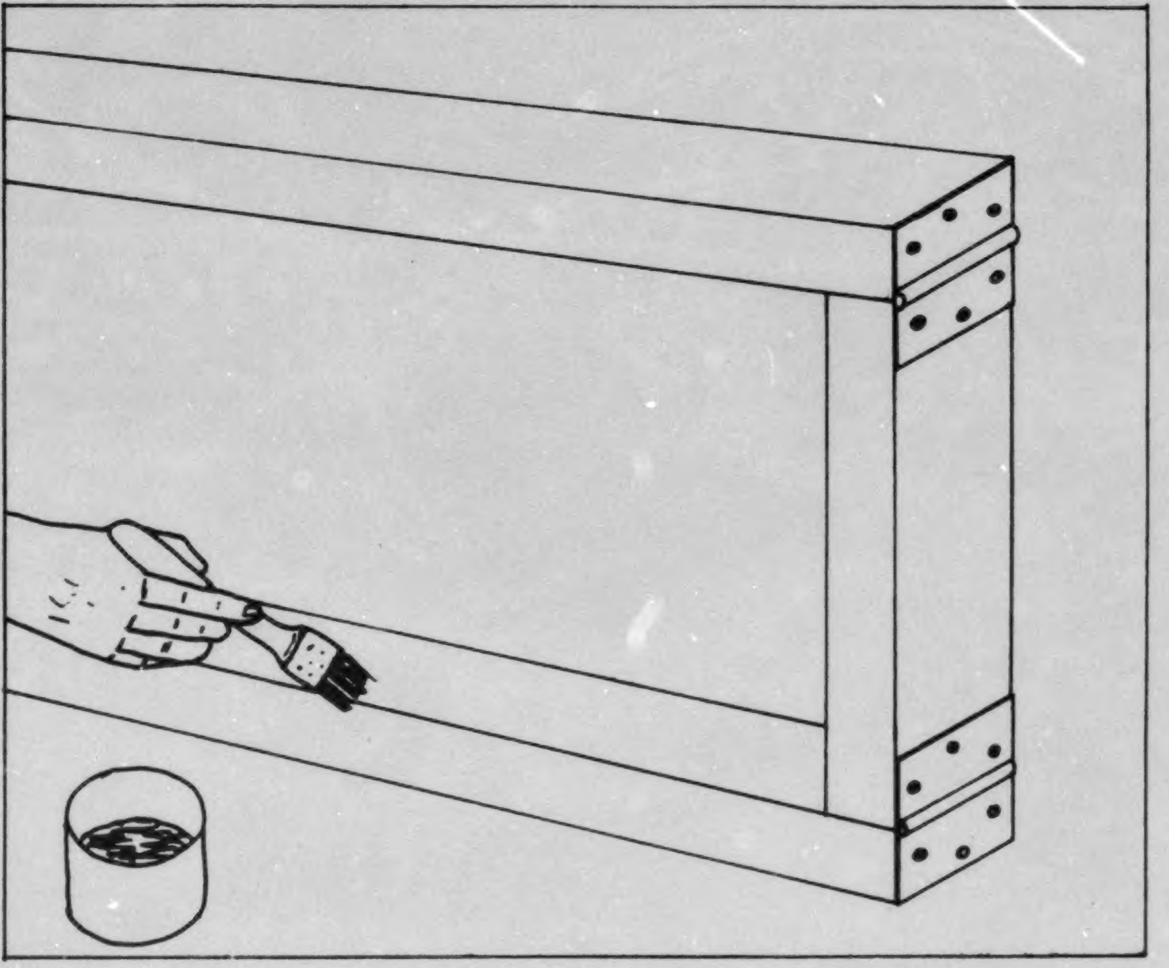


T-15

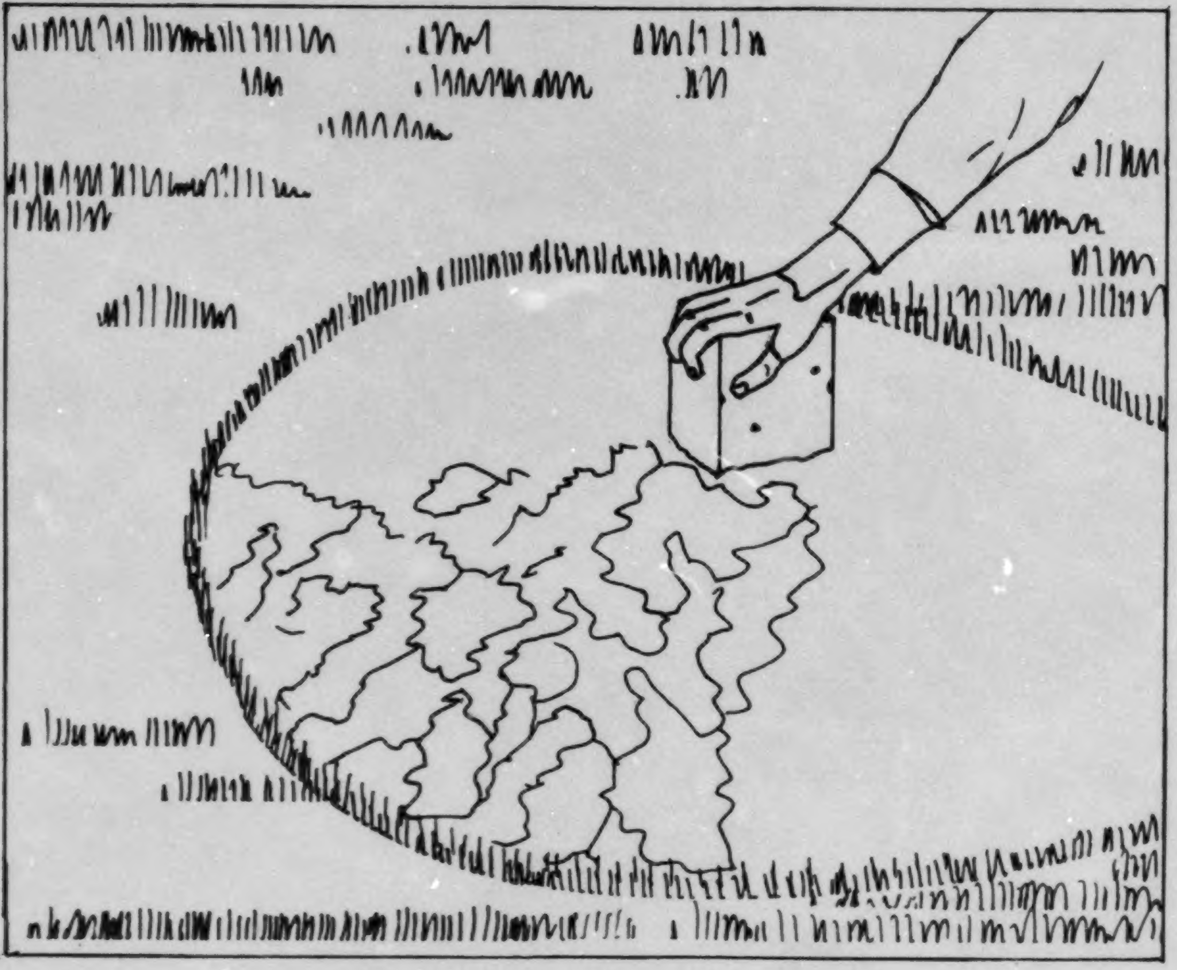
BRICK OR FLAGSTONE SUB-BASE


SURFACING MATERIAL
THIN MORTAR BED
FORM
3" CONCRETE SLAB
2" - 3" SAND BASE

PRECAST SQUARES

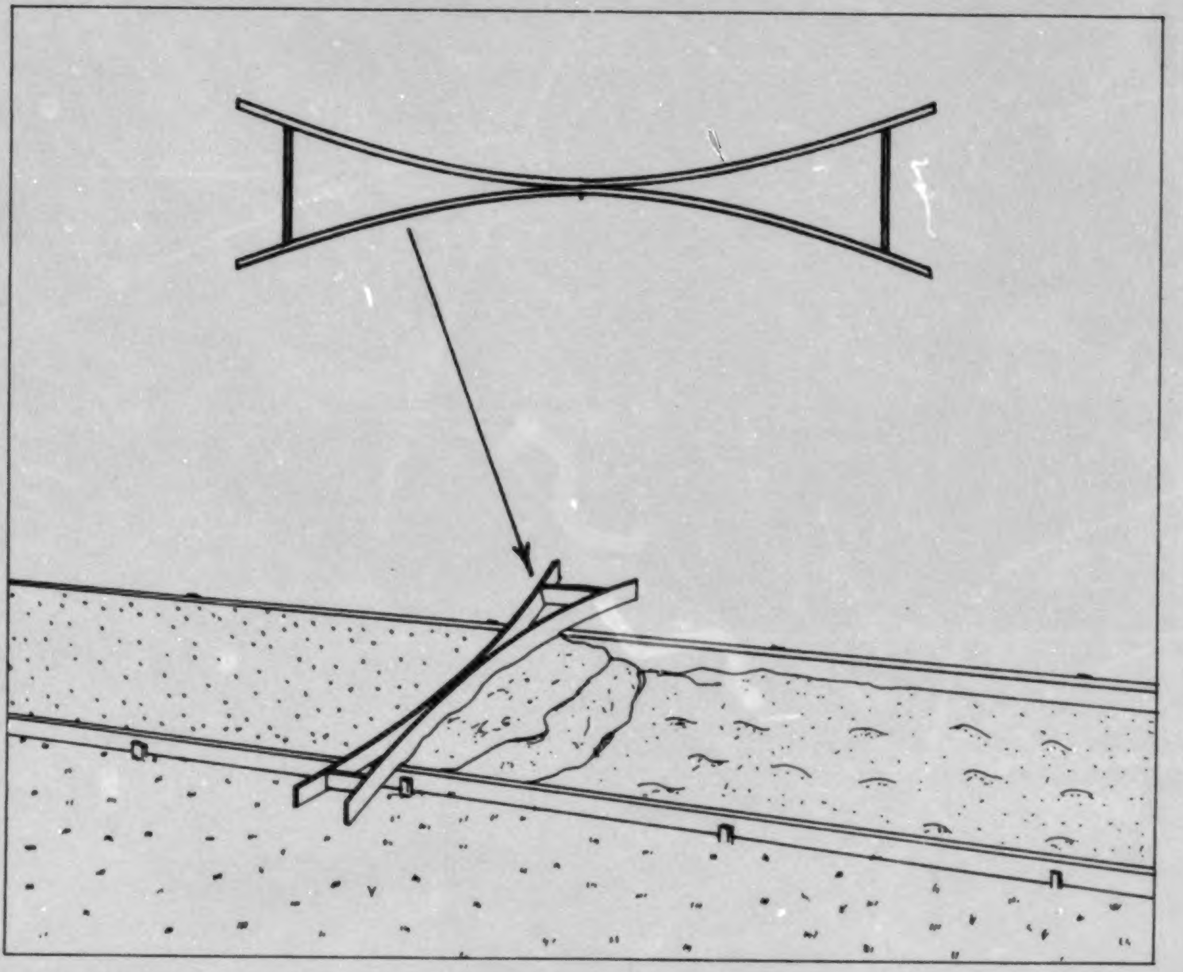


FINISHING STEPPING STONES



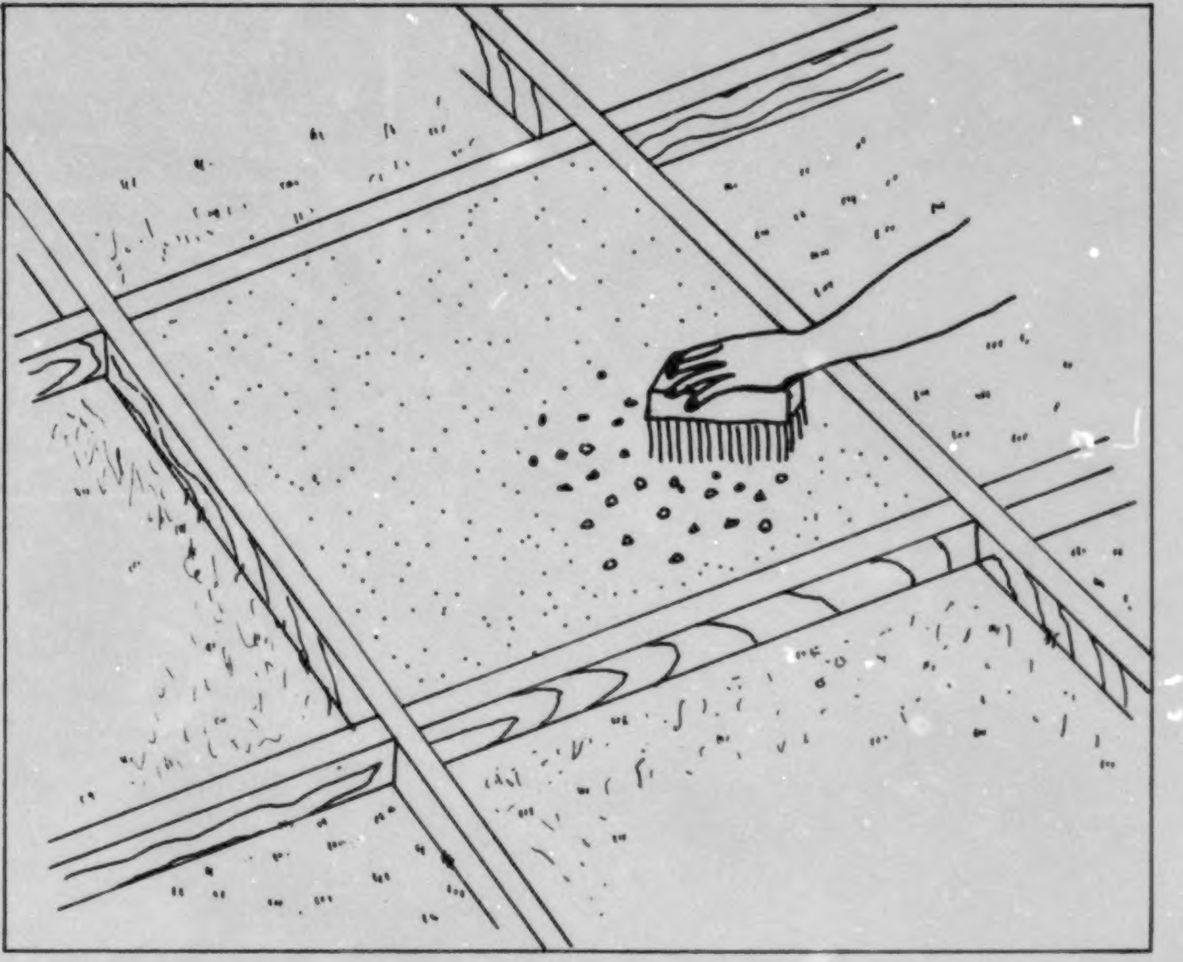
T-18

SCREED BOARD



T19

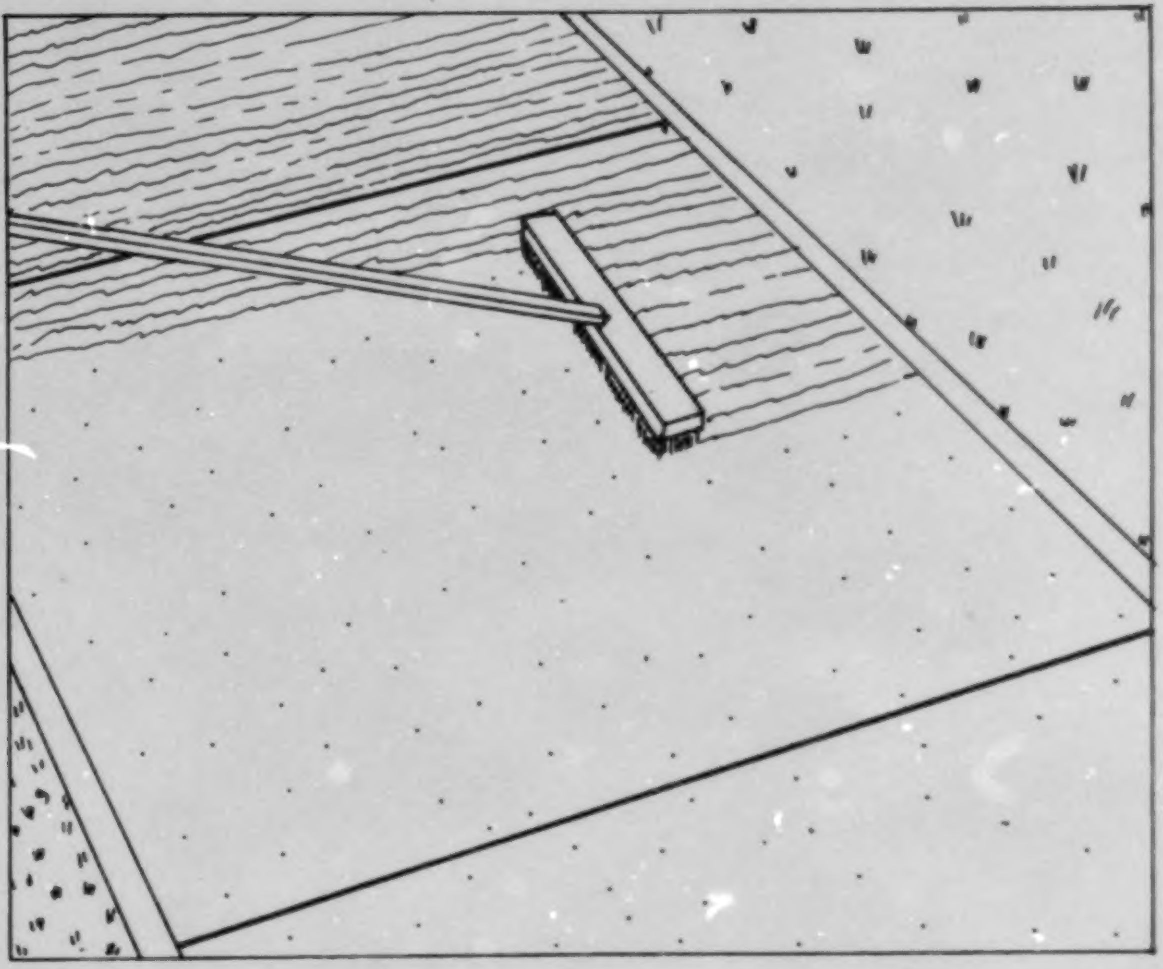
TEXTURE THE SURFACE BY BRUSHING WITH A STEEL BRUSH



T-20

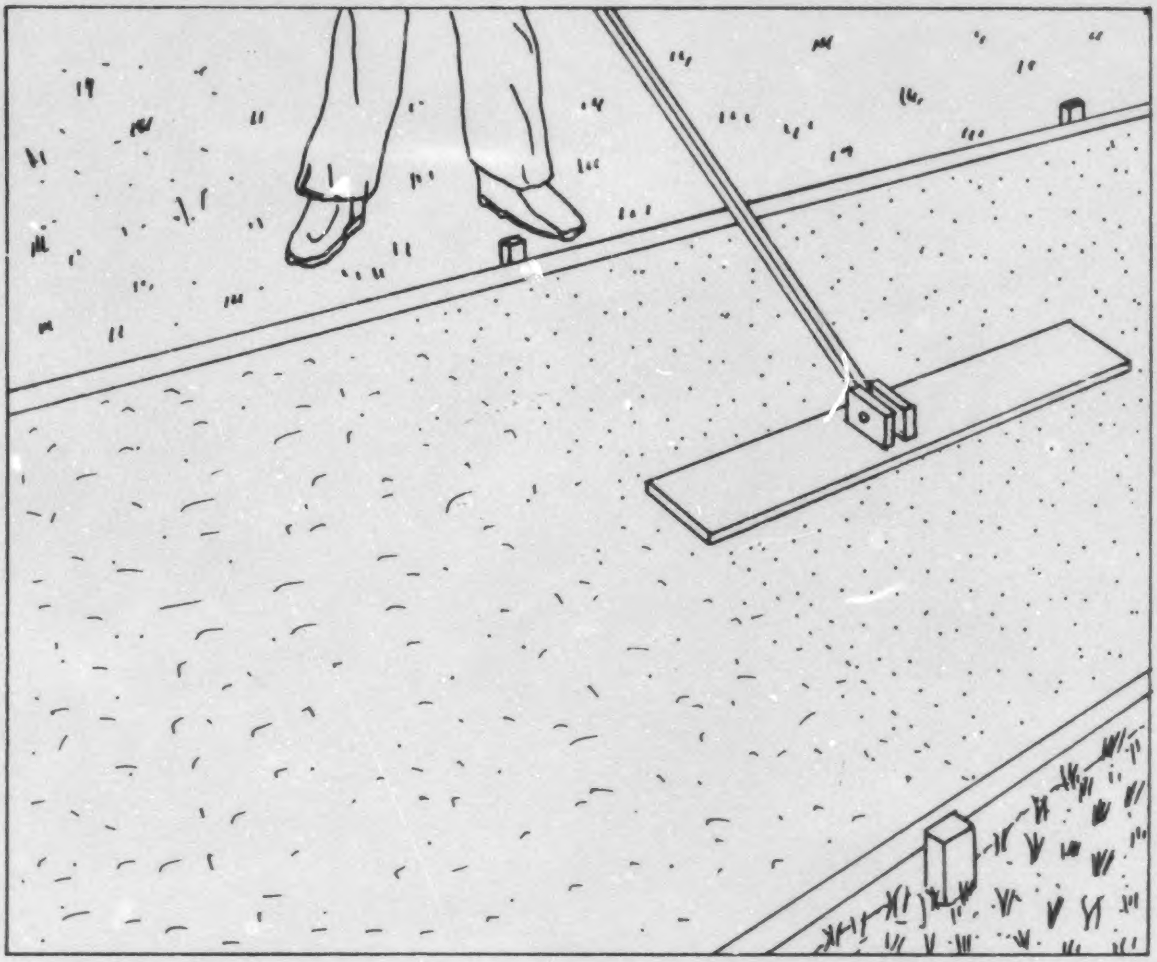
725

A BROOM GIVES TEXTURE



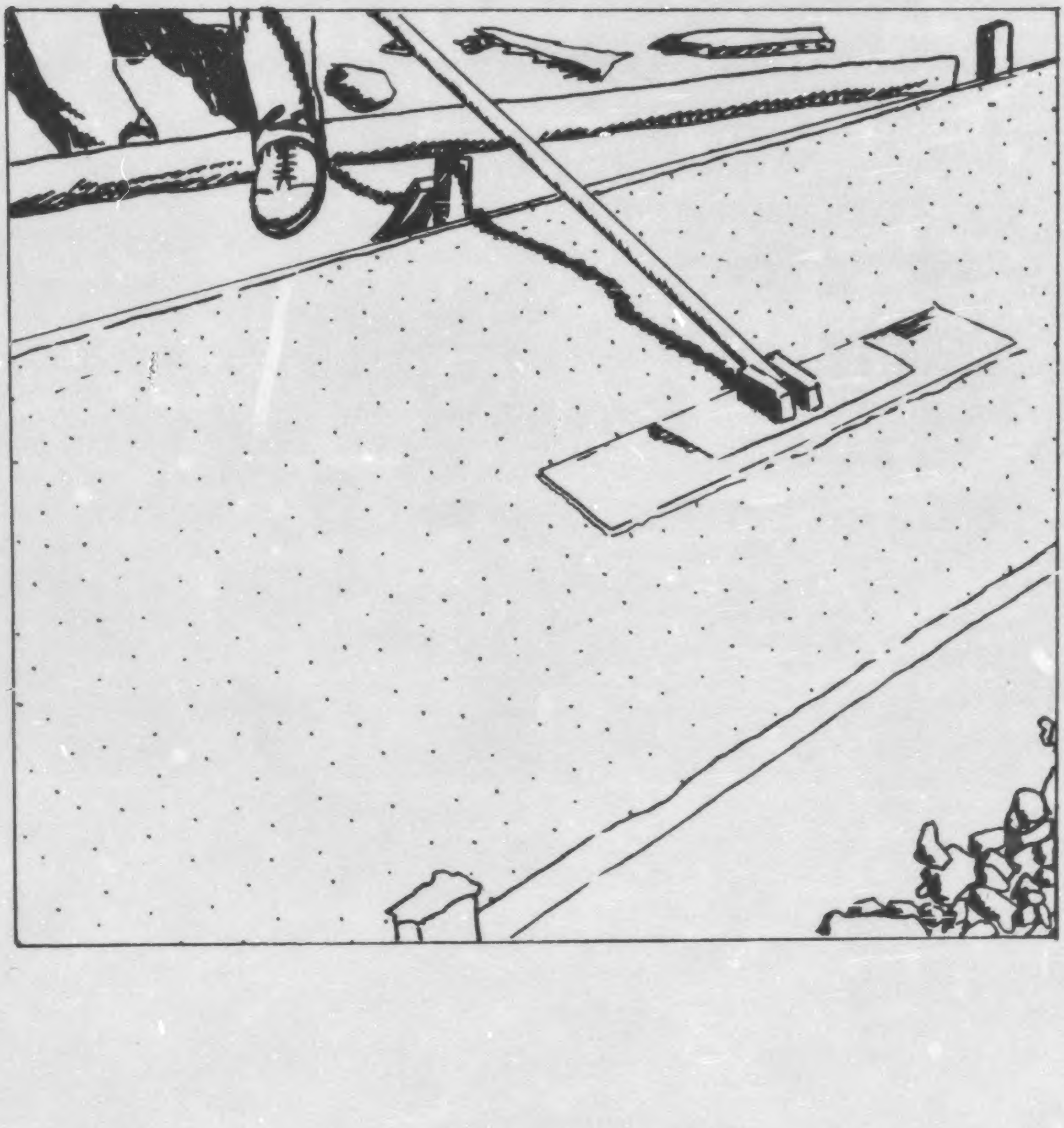
T-21

FLOATING WITH A WOOD TROWEL

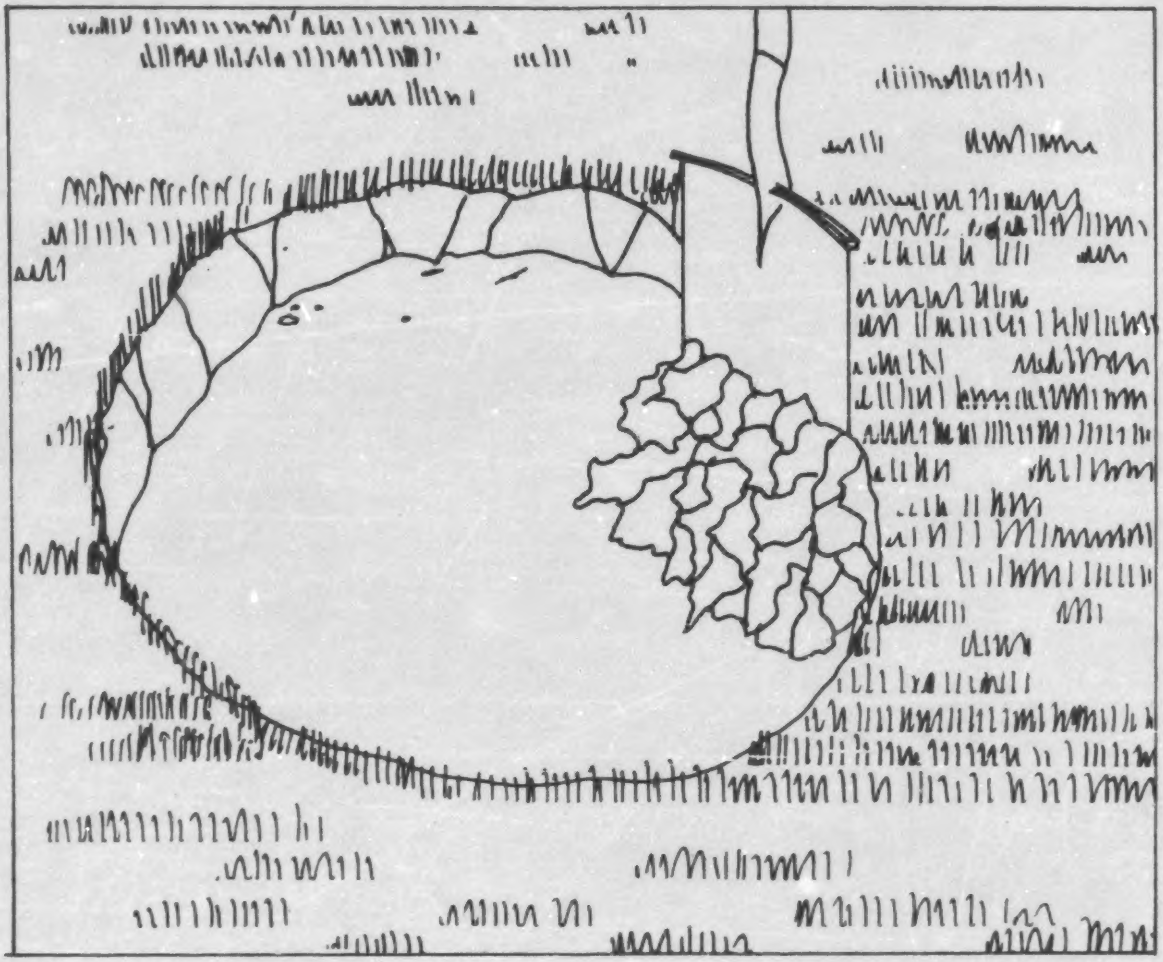


727

FLOATING CONCRETE

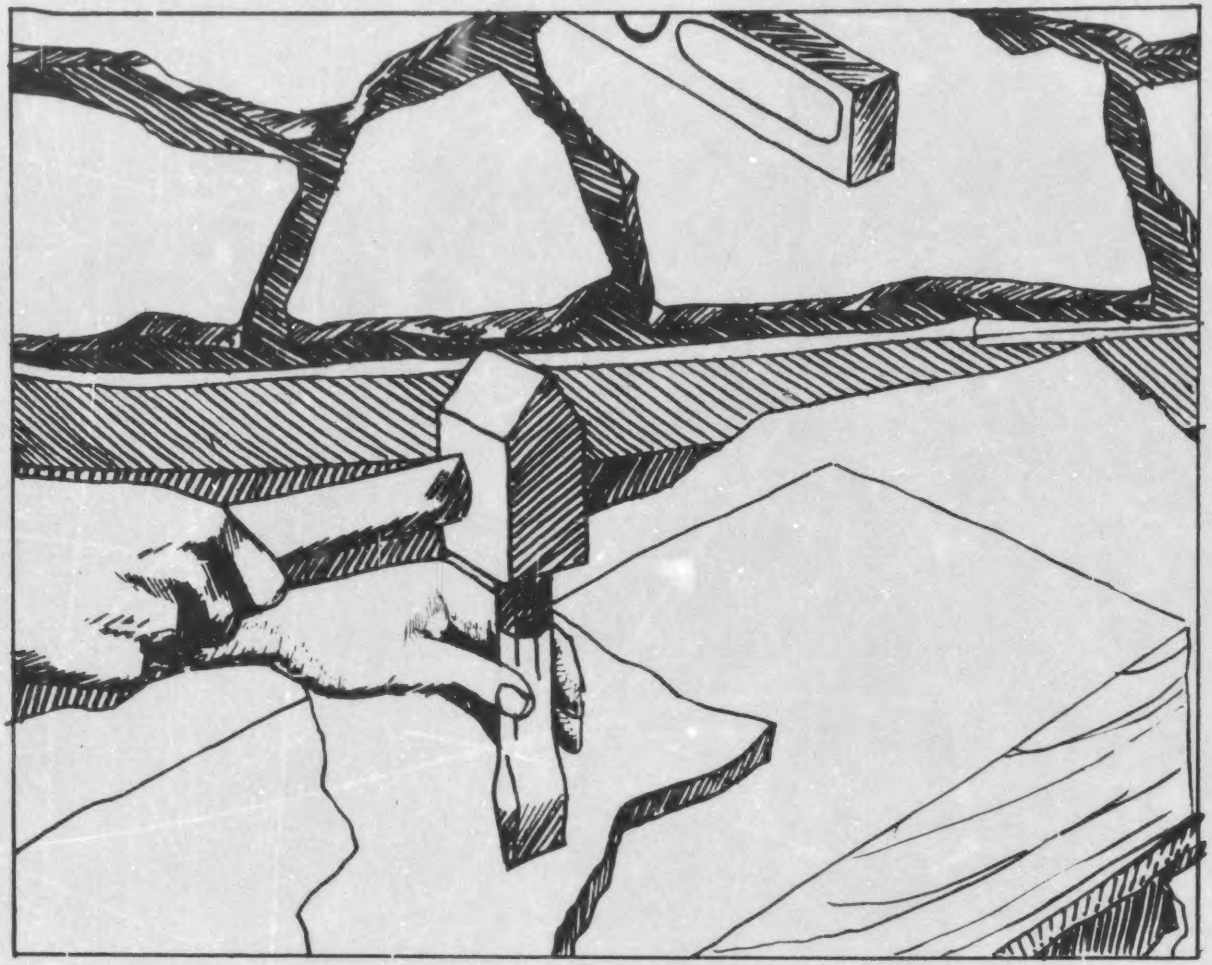


CONSTRUCTING STEPPING-STONES



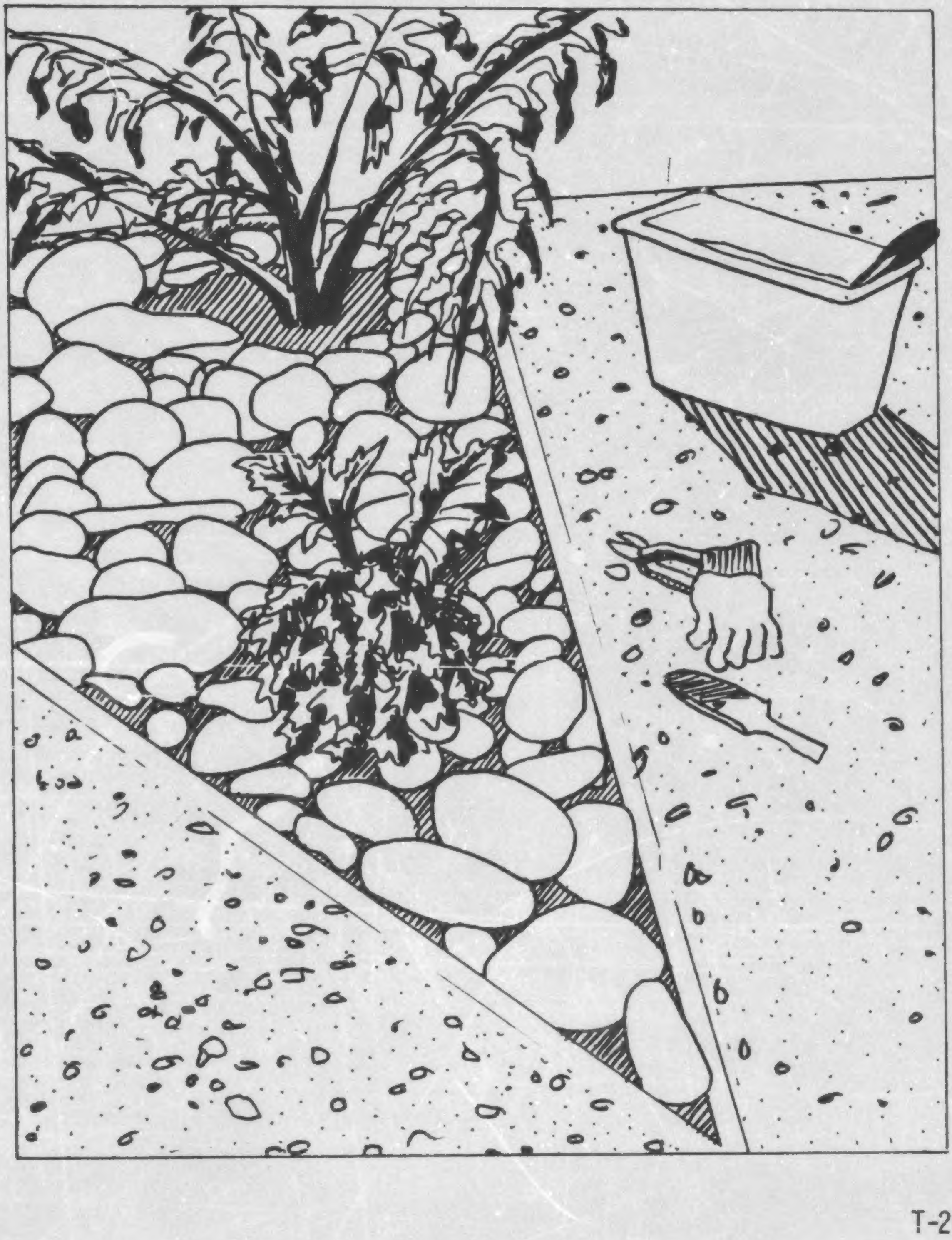
T-24

CUTTING FLAGSTONE



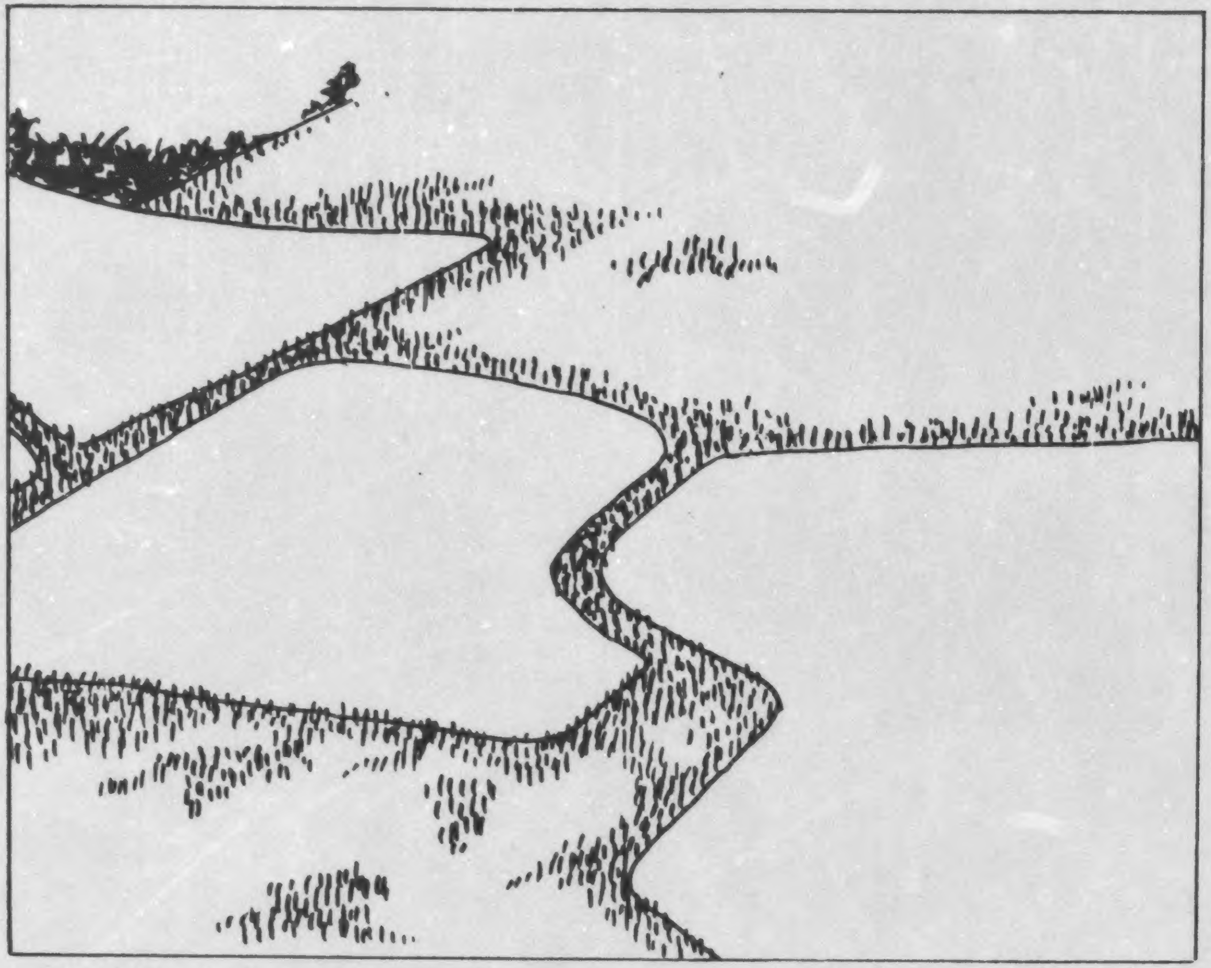
T-25

EXPOSED WASHED AGGREGATE ACCOMPANIED BY A PLANTER WITH SMOOTH STONES



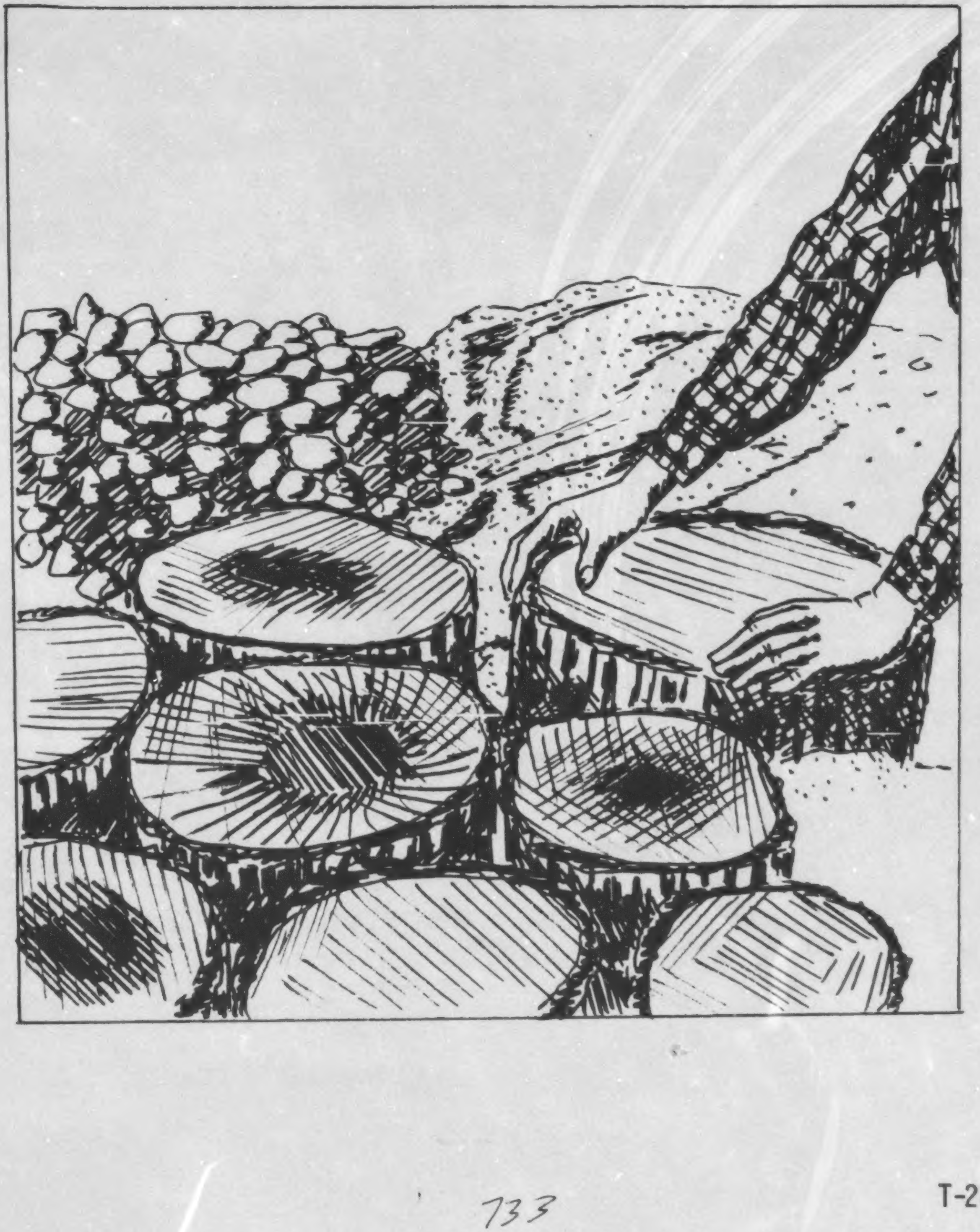
T-26

IRREGULAR FLAGSTONE WITH SOD JOINTS

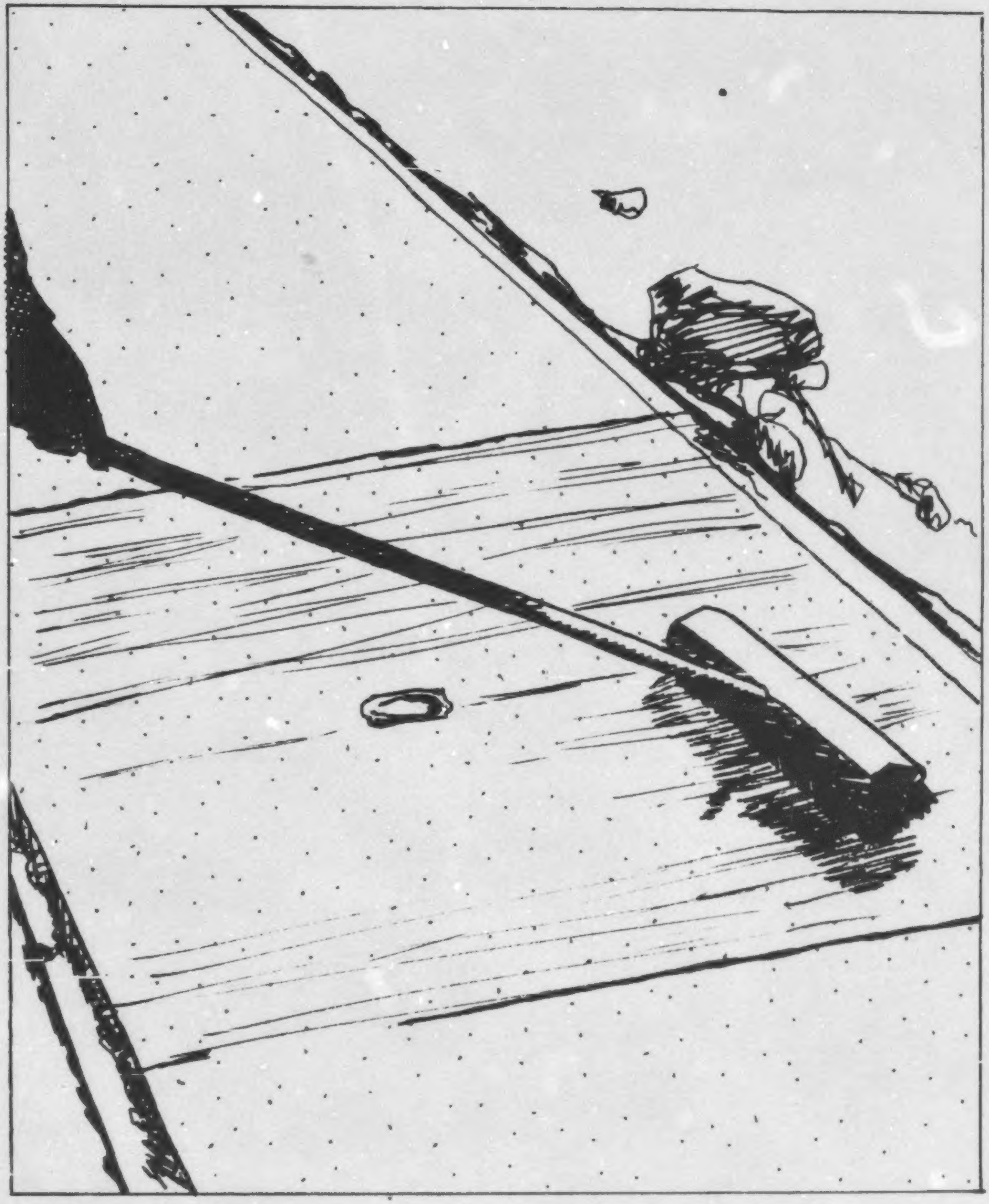


T-27

LOG CROSS-SECTIONS FOR SURFACE

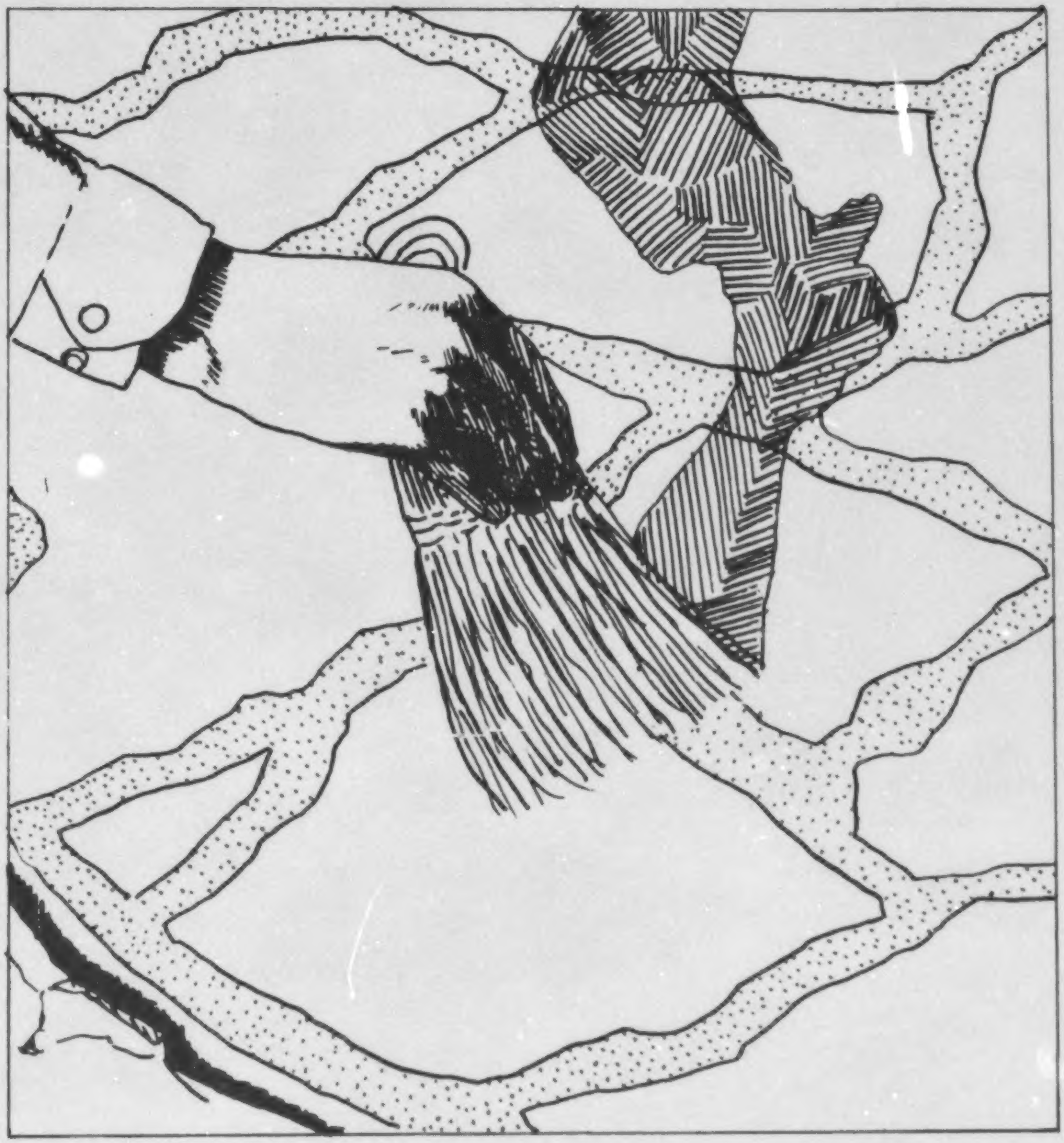


FINISHING CONCRETE WITH A BRUSHED TEXTURE



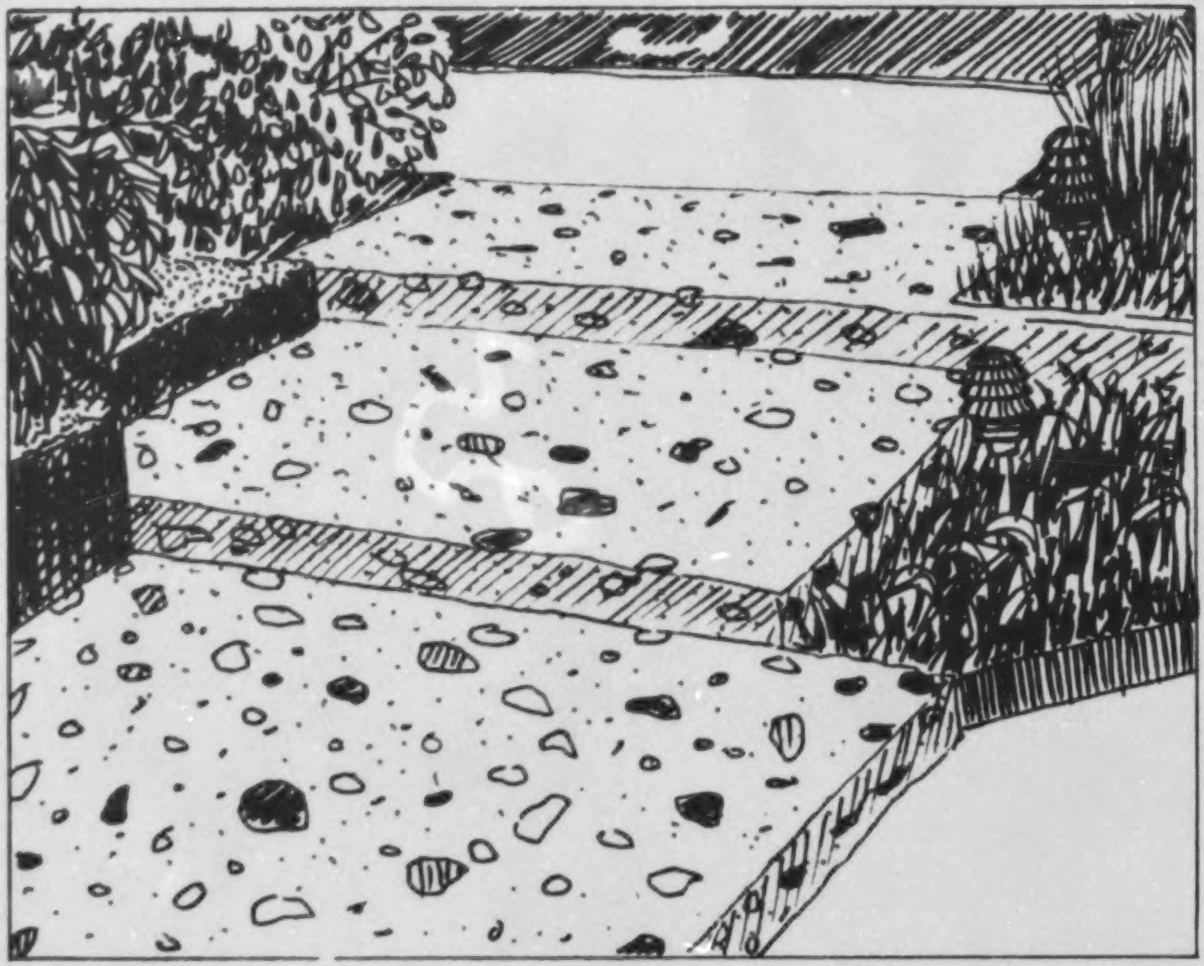
T-29

REMOVING EXCESS SAND AFTER FILLING JOINTS



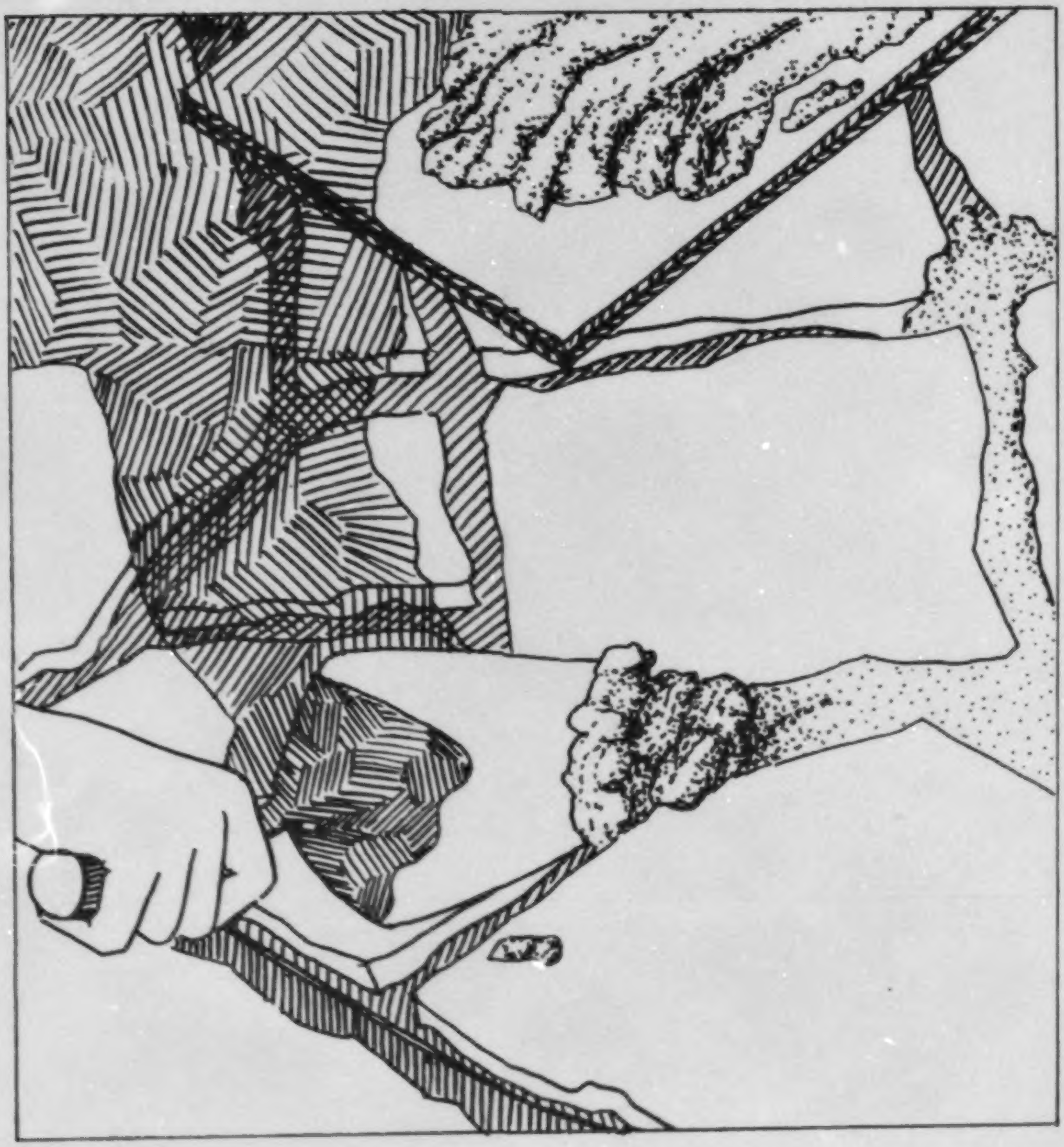
T-30

CONCRETE STEPS WITH EXPOSED AGGREGATE AND 12 VOLT LIGHTING



T-31

USING A TROWEL TO FILL FLAGSTONE JOINTS WITH MORTAR



T-32

737

Adult Unit No. 22

GRAIN DRYING AND STORAGE ALTERNATIVES

A Resource Unit For Adult Education
Classes in Agriculture

Developed by
James D. Cooper

Edited by
L. H. Newcomb

Department of Agricultural Education
College of Agriculture and Home Economics
The Ohio State University
Columbus, Ohio 43210

1975

738

PREFACE

THIS RESOURCE UNIT WAS DEVELOPED AS A PART OF A PROJECT TITLED, "INSERVICE EDUCATION OF VOCATIONAL AGRICULTURE TEACHERS ON NEW CURRICULAR MATERIALS FOR ADULT CLASS INSTRUCTION." EDUCATIONAL PROFESSIONAL DEVELOPMENT ACT FUNDS WERE OBTAINED FROM THE REGIONAL U. S. OFFICE OF EDUCATION IN CHICAGO THROUGH THE STATE DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION IN OHIO TO CONDUCT THE PROJECT. THE PROJECT WAS CONDUCTED FROM AUGUST 1, 1974 THROUGH JULY 31, 1975. INCLUDED IN THE PROJECT WERE WORKSHOPS WHICH PROVIDED INSTRUCTION CONCERNING DEVELOPMENT AND UTILIZATION OF THE UNITS.

THE PROJECT STAFF CONSISTED OF J. DAVID MCCRACKEN AND LAWRENCE H. NEWCOMB, PROJECT CO-DIRECTORS AND WAYNE R. LONGBRAKE, GRADUATE RESEARCH ASSOCIATE. SPECIAL APPRECIATION IS EXPRESSED TO MR. LONGBRAKE WHO ASSUMED MUCH OF THE RESPONSIBILITY IN ASSISTING AUTHORS WITH THE SPECIFIC CONTENT OF THE UNITS. APPRECIATION IS ALSO EXPRESSED TO EACH OF THE VOCATIONAL AGRICULTURE TEACHERS IN THE STATE OF OHIO WHO ASSISTED WITH THE PROJECT BY DEVELOPING UNITS AND BY FIELD TESTING THE INITIAL UNITS PRIOR TO THEIR REVISION AND FINAL PREPARATION.

J. DAVID MCCRACKEN	L. H. NEWCOMB
ASSISTANT PROFESSOR	ASSISTANT PROFESSOR

TABLE OF CONTENTS

PAGE

PREFACE III

INTRODUCTION 1

NATIONAL AND STATE SITUATION 3

LOCAL SITUATION 3

OBJECTIVES 3

REFERENCES 3

NEEDED AV EQUIPMENT 4

ALTERNATIVE INTEREST APPROACHES 4

QUESTIONS TO BE ANSWERED 4

LEARNING ACTIVITIES 5

TO SUMMARIZE (NOTE TO TEACHER) 5

APPLICATION 5

APPENDIX A: CONTENT SUMMARY 6

APPENDIX B: INSTRUCTIONAL MATERIALS 14

INTRODUCTION

THESE TEACHING MATERIALS HAVE BEEN DESIGNED TO ALLOW TEACHERS IN VOCATIONAL AGRICULTURE TO TEACH YOUNG FARMERS AND ADULTS WITH THE MINIMUM AMOUNT OF PREPARATION. THERE ARE A NUMBER OF HEADINGS THAT ARE USED IN THE UNIT FORMAT WHICH NEED SOME ADDITIONAL EXPLANATION.

STATE SITUATION: THIS IS MERELY INFORMATION WHICH HELPS TO GIVE THE TEACHER AN OVERVIEW OF WHAT'S HAPPENING THROUGHOUT THE STATE AND MIGHT PROVIDE A BASIS FOR COMPARING WHAT'S GOING ON IN EACH LOCAL COMMUNITY.

LOCAL SITUATION: IT IS SUGGESTED THAT THE TEACHER USE LOCAL DATA TO DEVELOP A SITUATION WHICH IS MORE PRECISE FOR HIS PARTICULAR CLIENTELE. DATA FROM LOCAL FARMS SHOULD BE USED TO HELP DEVELOP THIS. IT CAN HELP YOUNG FARMERS AND ADULTS SEE HOW THEY COMPARE WITH THE STATE AND TO EACH OTHER.

OBJECTIVES: THESE ARE INSTRUCTIONAL OBJECTIVES SET FORTH BY THE TEACHER AND REPRESENT STATEMENTS OF INTENDED OUTCOMES THAT THE TEACHER HOPES TO ACCOMPLISH BY USING THIS UNIT OF INSTRUCTION.

REFERENCES: THIS CATEGORY INCLUDES INFORMATION THAT THE TEACHER WILL NEED AS BACKGROUND INFORMATION IN ORDER TO DO AN EQUITABLE JOB OF TEACHING THE UNIT.

NEEDED AV EQUIPMENT: THIS IS A LISTING OF THE EQUIPMENT THAT IS NEEDED TO GET READY TO TEACH THIS COURSE.

ALTERNATIVE INTEREST APPROACHES: THIS SECTION WILL INCLUDE A NUMBER OF POSSIBLE WAYS ONE MIGHT GO ABOUT GAINING THE INTEREST OF THE GROUP. THE TEACHER SHOULD NOT EXPECT TO USE ALL OF THE INTEREST APPROACHES PRESENTED IN THIS SECTION, RATHER HE SHOULD SELECT THE INTEREST APPROACH OR APPROACHES THAT BEST SUITS HIS TEACHING STYLE AND SITUATION. THERE MAY VERY WELL BE CASES WHERE INDIVIDUAL TEACHERS HAVE BETTER IDEAS AND INTEREST APPROACHES THAN THOSE PRESENTED IN THIS SECTION. IF THAT IS THE CASE THE TEACHER SHOULD SUBSTITUTE HIS OWN WAY OF GETTING THE ADULTS' INTEREST IN PURSUING THE UNIT.

QUESTIONS TO BE ANSWERED: THIS IS A LIST OF THE BASIC QUESTIONS THAT SHOULD BE ANSWERED THROUGH STUDYING THIS RESOURCE UNIT. THE QUESTIONS ARE LOGICALLY SEQUENCED AND COMPLETE ENOUGH SUCH THAT WHEN THE ANSWERS TO ALL THE QUESTIONS ARE UNDERSTOOD THE OBJECTIVES OF THE UNIT WILL BE MET.

LEARNING ACTIVITIES (UNDER EACH QUESTION): FOR EACH OF THE QUESTIONS THE TEACHERS WHO PREPARED EACH UNIT HAVE TRIED TO DESIGN DIFFERENT TYPES OF LEARNING ACTIVITIES SUCH AS LECTURES, DISCUSSIONS, SLIDES, USE OF TRANSPARENCIES, EXPERIMENTS, DEMONSTRATIONS, ETC., THAT COULD BE USED TO HELP OTHER TEACHERS AND THE CLASS COME UP WITH THE ANSWER

141

TO THE QUESTION BEING CONSIDERED. INDIVIDUAL TEACHERS MAY WANT TO REVISE CERTAIN OF THESE LEARNING ACTIVITIES OR ADD ADDITIONAL LEARNING ACTIVITIES THAT WILL BE MORE FAVORABLY RECEIVED BY THEIR GROUP.

SUMMARY: WE HOPE THAT EACH TEACHER WILL MAKE A DETERMINED EFFORT TO SUMMARIZE THE QUESTIONS THAT HAVE BEEN ANSWERED AND PULL TOGETHER THE BASIC FACTS AND INFORMATION THAT HAVE BEEN PRESENTED IN THE STUDY OF THE UNIT.

APPLICATION: IN THIS SECTION WE HAVE TRIED TO DESIGN, IN THE UNITS WHERE IT SEEMS APPLICABLE, SOME APPROVED PRACTICES FOR TEACHERS TO GET THE FARMERS TO INCORPORATE INTO THEIR FARMING OPERATIONS. THIS SECTION OF THE UNIT SHOULD RECEIVE THE HEAVIEST EMPHASIS DURING INDIVIDUAL ON-FARM VISITATIONS WHERE THE TEACHER CAN HELP TO MOVE THE FARMER FROM WHERE HE IS TO WHERE HE SHOULD BE IN ORDER TO MAXIMIZE RETURNS.

CONTENT SUMMARY: THIS IS A SUMMARY OF THE BASIC TECHNICAL INFORMATION THAT HAS BEEN EXTRACTED FROM A NUMBER OF SOURCES. IT IS FOR TEACHER USE ONLY. WE FEEL THIS IS THE MINIMUM BACKGROUND READING THAT A TEACHER CAN DO AND HAVE ANY DEGREE OF SUCCESS IN TEACHING THIS UNIT. WE HAVE CONDENSED THE BASIC INFORMATION INTO THE CONTENT SUMMARY SO YOU, THE TEACHER, CAN HAVE A SUBJECT MATTER ADVANTAGE WHEN YOU GO INTO THE CLASSROOM. DEPENDING ON YOUR FORMER EXPERIENCES IN ANY PARTICULAR AREA, YOU MAY FIND IT NECESSARY OR DESIRABLE TO GO BACK TO THE REFERENCES LISTED EARLIER FOR MORE DETAILED INFORMATION AND BACKGROUND READING.

INSTRUCTIONAL MATERIALS: THESE MATERIALS ARE PROVIDED TO HELP THE TEACHER. THERE ARE TRANSPARENCY MASTERS WHICH MAY BE USED TO ILLUSTRATE POINTS. IN SOME CASES SLIDES AND/OR OTHER TYPES OF VISUAL AIDES ARE PROVIDED. SOME UNITS MAY INCLUDE SOME EXTENSION LEAFLETS OR REPRINTS FROM COMMERCIAL COMPANIES. IN ADDITION, THE TEACHER MAY WANT TO MAKE SOME INSTRUCTIONAL MATERIALS ON HIS OWN TO BE ADDED TO THE UNIT TO MAKE IT MORE COMPATIBLE TO THE LOCAL COMMUNITY.

742

GRAIN DRYING AND STORAGE ALTERNATIVES

NATIONAL AND STATE SITUATION

IN 1973, THE UNITED STATES PRODUCED 5.678 BILLION BUSHELS OF CORN. OF THIS, OHIO ACCOUNTED FOR 282,345,000 BUSHELS. THE BULK OF THIS IS HARVESTED WITHIN A TWO MONTH PERIOD. THIS POSES A TREMENDOUS STORAGE AND TRANSPORTATION PROBLEM. WITH THE INCREASING TREND TOWARD LARGER MACHINERY, THIS WILL SHORTEN THE HARVEST TIME COMPOUNDING THE ALREADY PRESENT PROBLEM OF GRAIN HANDLING. WHEN HARVEST TIME COMES, THE BOTTLENECT IS NO LONGER IN THE HARVESTING, BUT IN THE TRANSPORTATION AND DRYING OF GRAINS. BANKRUPTCY, DISCONTINUENCE OF MANY RAIL LINES, AND INCREASED TRUCKING COSTS HAVE MULTIPLIED THE PROBLEMS AND FORCED MANY FARMERS TO BUILD HOME DRYING AND STORAGE SYSTEMS.

LOCAL SITUATION

TAKE A PHONE SURVEY OF THE LOCAL ELEVATORS TO OBTAIN INFORMATION AS TO THE STORAGE CAPACITY, DRYING CHARGES, TYPES OF CHARGES (DELAYED PRICE AND CONVENTIONAL STORAGE), AND PRESENT PRICES. COMPILE THIS INFORMATION INTO A CHART WHICH CAN BE USED ON AN OVERHEAD PROJECTOR.

OBJECTIVES

1. ACQUAINT THE FARMER WITH THE INCREASED NEED FOR BETTER MARKETING SKILLS.
2. PRESENT THE VARIOUS MARKETING PROCEDURES AVAILABLE.
3. HAVE THE STUDENT BE ABLE TO EVALUATE HIS OWN FARM SITUATION AND MAKE AN INTELLIGENT DECISION BASED ON ACCURATELY COMPILED FACTS AS TO THE BEST GRAIN HANDLING SYSTEM FOR HIS FARM.

REFERENCES

BARR, WALLACE. TRADE IN FARM PRODUCTS: FACTS, PRINCIPLES, EFFECTS. THE OHIO STATE UNIVERSITY, DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY, ESO - 189, APRIL 1974.

LEWIS, WILEY B., PH.D. INDIVIDUAL STUDY GUIDE FOR DRYING CORN ON THE FARM. COLUMBUS, OHIO: THE OHIO STATE UNIVERSITY, DEPARTMENT OF AGRICULTURE EDUCATION, AGDEX 111/736, 1970.

MILNER, ROSS. HOW TO DETERMINE SHRINKAGE IN GRAIN. COLUMBUS, OHIO: THE OHIO STATE UNIVERSITY, COOPERATIVE EXTENSION SERVICE, BULLETIN 425, SEPTEMBER 1962.

Sharp, John W. *Description of Some of the More Common Methods of Title Transfers Used in Marketing Grain by Farmers*. Columbus, Ohio: The Ohio State University, Department of Agriculture, Economics and Rural Sociology, ESO 191, April 1974.

Sharp, John W. *Grain Crop Production Data for the U.S. and the World*. Columbus, Ohio: The Ohio State University, Department of Agriculture and Rural Sociology, ESO 198, May 1974.

Shaudys, E. T. and Baker, R. H. *Farm Custom Rates Paid in Ohio*. Columbus, Ohio: The Ohio State University, Department of Agricultural Economics and Rural Sociology, L-74, May 1974.

________________. *Planning Grain-Feed Handling for Livestock and Cash-Grain Farms*. Columbus, Ohio: The Ohio State University, Cooperative Extension Service, MWPS-13, 1968.

Needed AV Equipment

Chalkboard, overhead projector, and opaque projector (optional).

Alternative Interest Approaches

Alternative A. Ask farmers in the group who have home storage systems *how* and *why* they arrived at the decision to buy them (use discretion).

Alternative B. Using a member's operation, work through a cost analysis of the various alternatives of grain storage and handling open to him (this takes prior notice of the individual and preparation by the teacher).

Alternative C. Give the local cash-grain prices for the day, then prices one month previous from a number of local elevators. They will usually be surprised at the differences in prices within a small area. Ask why there is such a difference.

Questions to be Answered

1. Is the crop needed for livestock feed?
2. Should the farmer forward contract, store, sell, or sell and buy futures?
3. Should he store at home or at a local elevator?
4. If stored at home, how is the grain to be dried?
5. Where and how do you lay-out a grain handling system?

6. WHAT ARE THE FACTORS TO BE CONSIDERED BEFORE DECIDING ON A SYSTEM?

LEARNING ACTIVITIES

1. IS THE CROP NEEDED FOR LIVESTOCK FEED?

USING TRANSPARENCY #1 DISCUSS THE POINTS PRESENTED.

2. SHOULD THE FARMER FORWARD CONTRACT, STORE, SELL, OR SELL AND BUY FUTURES?

USE INFORMATION PRESENTED ON TRANSPARENCIES #2 AND 3.

3. SHOULD HE STORE AT HOME OR AT A LOCAL ELEVATOR?

DISCUSS TRANSPARENCIES #4 AND 5.

4. IF STORED AT HOME, HOW IS THE GRAIN TO BE DRIED?

USE TRANSPARENCY #6 TO COMPARE BIN VS. BATCH AND CONTINUOUS FLOW DRYING.

5. WHERE AND HOW DO YOU LAY-OUT A GRAIN HANDLING SYSTEM?

UTILIZE TRANSPARENCIES #7 AND 8 TO DISCUSS PLANNING OF GRAIN HANDLING SYSTEMS.

6. WHAT ARE THE FACTORS TO BE CONSIDERED BEFORE DECIDING ON A SYSTEM?

STRESS LOCAL AVAILABILITY OF FUELS, MANPOWER, AND FUTURE EXPANSION. PLAN AHEAD 15-20 YEARS.

TO SUMMARIZE (NOTE TO TEACHER)

IT IS IMPORTANT TO GIVE THE STUDENT THE FACTS NEEDED SO HE CAN MAKE AN INTELLIGENT DECISION, BUT IT IS EXTREMELY IMPORTANT NOT TO MAKE THE DECISION FOR HIM. IT HELPS TO KEEP THE CLASSROOM INFORMAL SO THE FARMERS FEEL AT EASE TO ASK QUESTIONS. REFER FREQUENTLY TO THE VARIOUS MEMBERS' PERSONAL SITUATIONS WHEN ASKING QUESTIONS.

APPLICATION

THIS LESSON CAN PARTIALLY BE EVALUATED BY THE QUESTIONS ASKED IN THE CLASSROOM; HOWEVER, THE BEST EVALUATION IS A FOLLOW-UP FARM VISIT WHERE YOU REVIEW THE DECISION MAKING PROCESS AS IT APPLIES TO HIS OWN GRAIN FARM. THIS SHOULD BE DONE WITHIN A FEW WEEKS AFTER THE LESSON.

APPENDIX A

CONTENT SUMMARY

1. FACTORS TO CONSIDER WHEN MAKING GRAIN HANDLING DECISIONS
    A. LIVESTOCK ON THE FARM
    B. NO LIVESTOCK ON THE FARM (CASH GRAIN)
        (1) SELL AT LOCAL ELEVATOR OR TERMINAL AT TIME OF HARVEST
        (2) STORE AT HOME OR ELEVATOR
        (3) CONTRACT FOR FUTURE PRICE
        (4) DELAYED PRICE
        (5) SELL AT HARVEST AND BUY FUTURES
2. SELECTING A DRYING SYSTEM
    A. IN-STORAGE LAYER DRYING
    B. BATCH DRYING
    C. CONTINUOUS-FLOW DRYING

BASIC FACTORS TO CONSIDER WHEN MAKING GRAIN HANDLING DECISIONS

SINCE A GRAIN HANDLING SYSTEM MUST BE DESIGNED DIFFERENTLY FOR EACH PARTICULAR FARMSTEAD, IT IS A HIGHLY INDIVIDUALIZED SYSTEM. THE INSTRUCTOR'S JOB IS TO PRESENT THE FACTORS THAT SHOULD BE CONSIDERED IN PLANNING THE BEST SYSTEM FOR EACH FARMER'S SITUATION.

LIVESTOCK ON THE FARM

IF THE FARMER HAS LIVESTOCK THAT CONSUMES HIS GRAIN, HE NEEDS TO DECIDE WHERE THE MOST PROFITABLE PLACE IS TO STORE HIS GRAIN AND TO GRIND IT FOR FEED IF NECESSARY. FOR THIS DECISION, HE SHOULD CONSIDER THE FOLLOWING:

1. LABOR AVAILABLE FOR FEED GRINDING AND AT HARVEST TIME.
2. PRESENT MACHINERY AVAILABLE FOR GRINDING, TRANSPORTATION AND STORAGE.
3. DISTANCE TO ELEVATOR OR FEED MILL.
4. QUALITY OF GRAIN RECEIVED FROM ELEVATOR.
5. BULK SUPPLEMENT SAVINGS AND STORAGE.
6. TIMELINESS OF FEED GRINDING.

NO LIVESTOCK ON THE FARM (CASH-GRAIN)

THE QUESTION FACING THE CASH-GRAIN FARMER IS WHEN TO SELL AND THROUGH WHAT CHANNELS. THE OPTIONS OPEN TO HIM ARE:

1. SELL AT LOCAL ELEVATOR OR TERMINAL AT HARVEST.
2. STORE AT HOME OR AT ELEVATOR.
3. CONTRACT FOR FUTURES PRICE.
4. DELAYED PRICE OR
5. SELL AND SPECULATE WITH FUTURES CONTRACTS.

SELL AT LOCAL ELEVATOR OR TERMINAL AT TIME OF HARVEST

WITH THIS OPTION, THE FARMER HAULS HIS GRAIN DIRECTLY FROM THE FIELD TO THE ELEVATOR OR TERMINAL AT THE TIME OF HARVEST. THE PRICE IS QUOTED BY THE ELEVATOR FOR THAT DAY. THE ADVANTAGES TO THIS SYSTEM IS THAT THERE IS NO RISK DUE TO PRICE FLUCTUATIONS AFTER HARVEST. THE FARMER

GETS HIS CHECK IMMEDIATELY, AND DOES NOT TIE UP HIS CAPITAL IN THE GRAIN FOR AN EXTENDED PERIOD OF TIME. HE ALSO HAS NO STORAGE COSTS. DISADVANTAGES INCLUDE THE FACT THAT PRICES TEND TO BE LOWER AT HARVEST. ALSO, IT DOES NOT ALLOW FOR INCOME TRANSFER FOR TAX PURPOSES.

STORE AT HOME OR ELEVATOR

A FARMER MAY ELECT TO STORE HIS GRAIN ANTICIPATING THAT PRICES MAY GO UP, TO TRANSFER HIS INCOME TO THE NEXT YEAR, OR TO SELL OFF AT REGULAR INTERVALS TO STEADY HIS INCOME.

DISADVANTAGES OF THIS SYSTEM ARE: PRICES MAY GO DOWN INSTEAD OF UP, THE COST OF STORAGE, AND THE RISKS OF LOSS BY NATURAL DISASTER.

CONTRACT FOR FUTURES PRICE

MOST ELEVATORS OFFER TO FARMERS THE OPTION OF SETTING A CONTRACT PRICE FOR THE GRAIN EARLY IN THE SEASON. THIS OPTION ALLOWS THE FARMER TO LOCK IN A PRICE FOR HIS GRAIN BEFORE HARVEST. IF HE HAS A GOOD RECORD KEEPING SYSTEM, HE CAN ACCURATELY PREDICT HIS COSTS AND KNOW WHEN HE IS LOCKING IN A REASONABLE AMOUNT OF PROFIT FOR HIS CROP IN ADVANCE.

DISADVANTAGES OF THIS SYSTEM ARE THAT CONTRACTS USUALLY HAVE A DELIVERY DATE AND IF WEATHER DELAYS HARVEST SO DELIVERY CANNOT BE MADE ON TIME, THE FARMER CAN BE PENALIZED. ALSO, IF THE PRICE OF GRAIN RISES ABOVE THE CONTRACT PRICE, THE GRAIN MUST STILL BE DELIVERED AT THE CONTRACT PRICE. ANOTHER DANGER IS THAT IF THE FARMER OVER-CONTRACTS THE CROP AND A NATURAL DISASTER OCCURS AND DESTROYS THE CROP, THE FARMER MAY BE FORCED TO BUY GRAIN TO FILL HIS CONTRACT. FOR THIS REASON, A FARMER SHOULD NOT CONTRACT MORE THAN 50 TO 60% OF HIS ANTICIPATED HARVEST.

DELAYED PRICE

THIS IS A RELATIVELY NEW OPTION OPEN TO GRAIN MARKETERS. WITH THIS OPTION, THE GRAIN IS USUALLY HAULED TO THE ELEVATOR AT THE TIME OF HARVEST, BUT THE SELLING PRICE IS NOT SET. THE SELLER HAS THE OPTION OF SELLING THE GRAIN AT ANY TIME WITHIN THE NEXT SIX TO NINE MONTHS, DEPENDING ON THE ELEVATOR POLICY. FOR THIS OPTION, THE FARMER PAYS A FEE. THIS IS SIMILAR TO STORING THE GRAIN IN THAT THE SELLER CHOOSES THE TIME OF SALE. HOWEVER, IT DIFFERS IN THAT THE ELEVATOR HAS TITLE TO THE GRAIN AND CAN PASS IT ALONG TO TERMINALS OR MILLERS. HE IS NOT REQUIRED TO STORE THE GRAIN ON THE PREMISES AS HE IS REQUIRED TO DO WITH STORAGE. THE ADVANTAGES OF THIS SYSTEM ARE SIMILAR TO THE ADVANTAGES OF STORAGE, BUT THE TIME HE CAN DELAY SELLING IS LIMITED. (ONE THING TO NOTE IS THAT MANY FARMERS FEEL THIS TENDS TO LOWER GRAIN PRICES, SINCE IT GIVES THE GRAIN BUYERS A MORE ACCURATE ACCOUNT OF THE GRAIN IN THE COUNTRY.)

SELL AT HARVEST AND BUY FUTURES

THIS OPTION IS FOR THE FARMER WHO WANTS TO SPECULATE ON GRAIN PRICES, BUT FOR SOME REASON CANNOT OR DOES NOT WANT TO STORE OR DELAY PRICE OF HIS GRAIN. HE SELLS HIS GRAIN AT HARVEST, THEN BUYS FUTURES CONTRACTS FOR GRAIN ON THE CHICAGO BOARD OF TRADE. BY DOING THIS, HE HAS LESS CAPITAL TIED UP BECAUSE HE CAN BUY A CONTRACT FOR APPROXIMATELY 10% OF THE ACTUAL GRAIN COST. HOWEVER, HE HAS THE TOTAL EARNING POWER OF THE GRAIN EVEN IF THE PRICE GOES UP. THE DISADVANTAGE OF THIS SYSTEM IS THAT THE FARMER MAY BE FORCED TO PUT UP MORE MARGIN IF THE PRICE OF THE GRAIN GOES DOWN. HE MUST BUY IN 5,00 BUSHEL LOTS AND PAY A BROKERAGE FEE.

SELECTING A DRYING SYSTEM

IF A FARMER DECIDES TO STORE GRAIN ON THE FARM, A MAJOR PROBLEM HE FACES IS SELECTING A DRYING SYSTEM.

GRAIN DRYING IS FREQUENTLY THE BOTTLENECK IN THE CORN HARVESTING/DRYING/STORAGE PROCESS. THE DRYING SYSTEM GUIDES OR MAY EVEN DICTATE FUNCTION AND CAPACITY FOR MANY OF THE OTHER FLOW COMPONENTS.

CURRENT GRAIN DRYING METHODS INCLUDE: LAYER DRYING IN THE BIN, BATCH DRYING IN THE BIN, BATCH DRYING IN MECHANIZED DRYERS, AND CONTINUOUS-FLOW DRYING IN MECHANIZED DRYERS. EACH OF THESE DRYING METHODS, WITH CORRECT MANAGEMENT, WILL PRODUCE DRY GRAIN OF GOOD QUALITY.

COMPARE DRYING ALTERNATIVES FIRST FOR DAILY DRYING CAPACITY AND THE INVESTMENT (FIXED COST) NECESSARY TO GET THAT CAPACITY. A NUMBER OF OTHER FACTORS CAN BE INVOLVED SUCH AS DRYING TEMPERATURE, AIR FLOW, HORSEPOWER, CONSTRUCTION TECHNIQUES AND MATERIALS, AND PORTABILITY. BUT, THESE DIFFERENCES FREQUENTLY ARE NOT GREAT ENOUGH BETWEEN TWO MODELS OF GOOD QUALITY EQUIPMENT TO FORCE THE DECISION. EXISTING DIFFERENCES FREQUENTLY CANNOT BE MEANINGFULLY MEASURED.

DIFFERENCES IN FUEL AND POWER COST (VARIABLE) WILL FREQUENTLY BE THE COST RELATED TO SPEED. IT USUALLY COSTS MORE TO GO FAST, BECAUSE OF SOME LOSS IN EFFICIENCY. YOU MAY, HOWEVER, GET A HIGHLY EFFICIENT DRYING METHOD THAT WILL NEVER GET YOUR CROP DRY -- IT IS TOO SLOW!

DRYING SYSTEMS ARE GENERALLY BASED ON 20 TO 25 OPERATING DAYS, AVAILABLE WITHIN A 45- TO 50-DAY NORMAL FALL-HARVEST SEASON. THERE IS A 90% PROBABILITY THAT THESE 20 TO 25 DAYS WILL BE REALIZED, AFTER RAINY DAYS AND SUNDAYS HAVE BEEN SUBTRACTED. THUS, 9 YEARS OUT OF 10, YOU CAN EXPECT TO HARVEST 30,000 BUSHELS AT 1,500 BU/DAY IN 20 DAYS.

ACTUALLY, THE HARVESTING OF OTHER CROPS, TENDING LIVESTOCK, AND MACHINERY BREAKDOWN CUT THE NUMBER OF AVAILABLE DAYS ON MANY FARMS. A 15 DAY OPERATING SEASON IS REALISTIC AS A DESIGN MODEL FOR MANY FARMERS. HARVESTING AT AN AVERAGE OF 1,500 BUSHELS PER DAY, THIS IS A 22,500 BUSHEL CROP HARVESTED AND DRIED. LOWER OR INCREASE THE DAILY RATE TO FIT OTHER VOLUMES.

THE VERY LARGE OPERATOR PROBABLY CANNOT AFFORD TO DESIGN HIS SYSTEM TO STAY TOTALLY WITHIN THE AVAILABLE 20 TO 25 DAYS. HE HAS TO BALANCE THE COST OF INCREASED HARVESTING/HANDLING/DRYING CAPACITY AGAINST THE VALUE OF THE ANTICIPATED INCREASE IN FIELD LOSS.

DRYING METHODS MAY CHANGE IN THE FUTURE. LEAVE SPACE IN THE LAYOUT FOR A POSSIBLE HIGH-TEMPERATURE DRYER. ALSO, BUILD NEW STORAGE BINS WITH THE PLENUM RING INSTALLED SO PERFORATED FLOORS CAN BE ADDED LATER.

MANY FARMERS USE MORE THAN ONE DRYING METHOD SIMULTANEOUSLY; FOR EXAMPLE, A HIGH-TEMPERATURE DRYER ALONG WITH A BIN DRYER. THE TWO DRYING METHODS MAY BE COMPLEMENTARY AND WILL PROVIDE EXPERIENCE ON WHICH FUTURE DECISIONS CAN BE BASED.

LARGER GRAIN VOLUMES AND SOME OF THE DRYING METHODS, PARTICULARLY THE HIGH-TEMPERATURE APPROACHES, REQUIRE MORE COMPLEX HANDLING SYSTEMS. THE LARGER GRAIN VOLUME REQUIRES A WELL-MECHANIZED HANDLING SYSTEM, READY TO GO, NO MATTER WHAT THE DRYING METHOD. THE COST OF THE MECHANIZED HANDLING IS CHARGED TO BOTH HIGH VOLUME AND DRYING SYSTEM.[1] THE FOLLOWING SYSTEMS WILL BE EVALUATED RELATIVE TO CORN.

IN-STORAGE LAYER DRYING

THIS SYSTEM IS EXACTLY WHAT ITS NAME IMPLIES -- THE GRAIN IS DRIED IN LAYERS IN THE STORAGE STRUCTURE. EACH LAYER IS PARTIALLY DRIED BEFORE THE NEXT ONE IS ADDED. THE RATE AT WHICH THE STRUCTURE CAN BE FILLED DEPENDS ON THE MOISTURE CONTENT OF THE GRAIN, THE DRYING UNIT CAPACITY, AND THE OPERATING PROCEDURE. THE ENTIRE DEPTH OF THE GRAIN IS ULTIMATELY DRIED IN PLACE.

UNHEATED FORCED AIR CAN HANDLE CORN FROM 18 TO 22% MOISTURE IN THIS SYSTEM. SINCE THIS IS A SLOW METHOD, IT IS NOT SUGGESTED FOR MORE THAN 4,000 BUSHELS UNLESS YOU HAVE SEVERAL DRYING UNITS. WHEN USING THIS SYSTEM, ONE MUST CONSIDER THE MAXIMUM ALLOWABLE TIME TO DRY SHELLED CORN AND PARTICULAR ATTENTION SHOULD BE DIRECTED TO THE PRACTICAL GRAIN DEPTHS AT THE VARIOUS MOISTURE LEVELS.

WHILE HEATED AIR CAN BE USED TO DRY CORN AT VARIOUS MOISTURE LEVELS BY VARYING THE DEPTH OF THE CORN LAYERS, 25% MOISTURE IS GENERALLY SUGGESTED AS THE MAXIMUM MOISTURE CONTENT. THE HEATED AIR SYSTEM IS PRACTICAL FOR 4,000 TO 10,000 BUSHELS OF GRAIN. WHEN THIS SYSTEM IS USED, THE FIRST LAYER SHOULD BE DRIED OR ALMOST DRIED BEFORE THE NEXT LAYER IS ADDED. THIS PROCEDURE IS CONTINUED UNTIL THE CORN IS DRIED AND THE BIN IS FILLED. AS EACH LAYER IS ADDED, THE ADDED RESISTANCE TO THE AIR FLOW REDUCES THE VOLUME OF AIR PER SQUARE FOOT OF FLOOR AREA. BY MAKING EACH SUCCESSIVE LAYER MORE SHALLOW THAN THE LAST, THE AIR VOLUME PER CUBIC FOOT IS MAINTAINED AND THE DRYING CAN BE COMPLETED BEFORE SPOILAGE OCCURS.

---

[1] ______________. PLANNING GRAIN-FEED HANDLING FOR LIVESTOCK AND CASH-GRAIN FARMS. COLUMBUS, OHIO: THE OHIO STATE UNIVERSITY, COOPERATIVE EXTENSION SERVICE, MWPS-13, 1968.

750

SOME MANUFACTURERS OF DRYING EQUIPMENT PROVIDE SCHEDULES FOR FILLING THE STORAGE UNIT THAT PERMIT USING THE PARTICULAR EQUIPMENT TO BEST ADVANTAGE AND HARVESTING AT A STEADY RATE.[2]

IN-STORAGE DRYING IS THE LOWEST-COST METHOD OF DRYING SHELLED CORN FOR ANNUAL VOLUMES OF UP TO 10,000 BUSHELS. IT ALSO HAS THE ADVANTAGE OF MINIMUM HANDLING REQUIREMENTS FROM HARVESTING TO STORAGE. THE MAJOR DISADVANTAGES OF THE SYSTEM ARE A RELATIVELY SLOW DRYING RATE AND A GREATER MANAGEMENT REQUIREMENT TO AVOID SPOILAGE DUE TO DRYING TOO SLOWLY AND EXCESSIVE OVER-DRYING. BECAUSE OF LOW AIR-FLOW RATES, IN-STORAGE DRYING IS NOT WELL ADAPTED TO USE IN THE VERY COLD WEATHER OFTEN ENCOUNTERED IN LATE NOVEMBER AND DECEMBER.[3]

BATCH DRYING

THERE ARE TWO FORMS OF BATCH DRYERS. THESE ARE GENERALLY IDENTIFIED AS THE BATCH-IN-BIN DRYER AND THE COLUMN BATCH DRYER. WHEN THE BATCH-IN-BIN SYSTEM IS USED, CORN IS SPREAD OVER A PERFORATED FLOOR AND DRIED IN A SHALLOW LAYER, USUALLY 2 TO 4 FEET DEEP. EACH DAY'S HARVEST IS DRIED IN THIS MANNER AND THEN MOVED TO A STORAGE STRUCTURE. THE DRYING BIN IS FILLED IN LAYERS AND DRIED IN PLACE AFTER THE OTHER STRUCTURES ARE FULL. THE BATCH-IN-BIN SYSTEM IS SUITABLE FOR USE WITH A PRODUCTION OF 8,000 BUSHELS OR MORE.

IN COLUMN BATCH, THE GRAIN STANDS IN A VERTICAL COLUMN, USUALLY 12 TO 24 INCHES THICK. THE CORN IS DRIED, COOLED, AND REMOVED TO A SEPARATE STORAGE STRUCTURE. THIS SYSTEM IS SUITABLE FOR USE WHERE 10,000 OR MORE BUSHELS OF CORN ARE TO BE DRIED ANNUALLY.

A SHALLOW LAYER OF GRAIN, 2 TO 4 FEET DEEP, FROM ONE DAY'S HARVEST IS DRIED IN 24 HOURS AND TRANSFERRED TO STORAGE. WHEN THE STORAGE BINS ARE FULL, THE DRYING BIN IS FILLED IN LAYERS AND DRIED. DRYING TEMPERATURE IS NORMALLY 110-130 DEGREES FAHRENHEIT. NO WET GRAIN STORAGE IS NEEDED SINCE A BATCH IS ONE DAY'S HARVEST.

BATCH UNITS DRY A FIXED AMOUNT OF GRAIN, COOL IT, AND THEN UNLOAD. SELF-LOADING AND UNLOADING IS COMMON AND RE-CIRCULATING OF GRAIN DURING THE DRYING CYCLE IS AN OPTIONAL FEATURE ON MANY UNITS. UNITS ARE ALSO AVAILABLE IN FULLY AUTOMATIC AND SEMI-AUTOMATIC CYCLE CONTROL, SO THE UNIT WILL PERFORM UNATTENDED. WET GRAIN STORAGE AHEAD OF THE DRYER IS VERY DESIRABLE.

---

[2] LEWIS, WILEY B., PH.D. INDIVIDUAL STUDY GUIDE FOR DRYING CORN ON THE FARM. COLUMBUS, OHIO: OHIO STATE UNIVERSITY, DEPARTMENT OF AGRICULTURE EDUCATION, AGDEX 111/736, 1970.

[3] MILNER, ROSS. HOW TO DETERMINE SHRINKAGE IN GRAIN. COLUMBUS, OHIO: OHIO STATE UNIVERSITY, COOPERATIVE EXTENSION SERVICE, BULLETIN 425, SEPTEMBER 1962.

751

BOTH TYPES OF BATCHES CAN HANDLE CORN WHICH HAS A MOISTURE CONTENT OF FROM 18 TO 30%. THE FOLLOWING RECOMMENDATIONS SHOULD BE CONSIDERED WHEN USING EITHER OF THESE SYSTEMS:

1. DO NOT OVERFILL, THAT IS, USE TOO LARGE A BATCH.
2. LIMIT THE DRYING TEMPERATURES TO THOSE RECOMMENDED. DO NOT DEPEND ON MANUAL CONTROL. USE THERMOSTATS TO CONTROL THE TEMPERATURE.
3. USE A SPREADER TO KEEP GRAIN LEVEL OVER ENTIRE FLOOR AND TO DISTRIBUTE THE BROKEN KERNELS AND CHAFF EVENLY.
4. IN MAKING MOISTURE TESTS, ALLOW FOR INACCURACIES OF TESTING WITH MOST ELECTRIC TESTERS DUE TO LACK OF MOISTURE EQUALIZATION IN KERNELS. BETTER ALLOW THE SAMPLE TO STAND IN A CLOSED CONTAINER FOR A PERIOD OF AT LEAST 12 TO 24 HOURS.
5. BE SURE TO COOL THE GRAIN THOROUGHLY FOLLOWING DRYING. THE COOLING HELPS TO EQUALIZE THE MOISTURE CONTENT. THE AMOUNT OF TIME REQUIRED FOR COOLING DEPENDS UPON THE TEMPERATURE USED DURING DRYING AND THE TIME REQUIRED FOR DRYING. THE HIGHER THE TEMPERATURE AND THE LONGER THE TIME, THE LONGER THE COOLING PERIOD MUST BE.
6. AERATE THE GRAIN (MOVE A SMALL AMOUNT OF AIR THROUGH THE GRAIN TO COOL IT AND EQUALIZE ITS TEMPERATURE) AFTER IT HAS BEEN PLACED IN STORAGE.[4]

THE TREND IN MODERN BATCH DRYER DESIGN IS TOWARD AUTOMATION OF THE COMPLETE DRYING CYCLE, INCLUDING LOADING AND UNLOADING. RAPID CYCLING OF THE SYSTEM PERMITS MORE BATCHES TO BE DRIED PER DAY, THUS GREATLY INCREASING THE DRYING CAPACITY. TIME-CYCLE CONTROL OF SYSTEM OPERATION REDUCES THE DEMAND FOR BOTH LABOR AND SUPERVISION. MANAGEMENT IS STILL REQUIRED, HOWEVER, TO CHECK INITIAL AND FINAL CORN MOISTURES AND TO CORRECT CONTROL SETTINGS WHEN NECESSARY. A DISADVANTAGE TO AUTOMATION OF BATCH DRYER OPERATION IS THE NEED FOR WET-CORN HOLDING CAPACITY AHEAD OF THE DRYER AND INCREASED INVESTMENT IN MORE SOPHISTICATED HANDLING EQUIPMENT AND CONTROLS.

CONTINUOUS-FLOW DRYING

CONTINUOUS-FLOW DRYING SYSTEMS ARE HIGH-TEMPERATURE, HIGH-AIR FLOW, HIGH-CAPACITY SYSTEMS BEST ADAPTED TO CORN HARVESTING, HANDLING AND STORAGE SYSTEMS OF ANNUAL VOLUMES OF 20,000 BUSHELS OR GREATER. AIRFLOW RATES OF 100 CFM[5] PER BUSHEL OR GREATER AND AIR TEMPERATURES OF 180

---

[4] LEWIS, WILEY B., IBID.

[5] CUBIC FOOT PER MINUTE

752

TO 240 DEGREES FAHRENHEIT ARE TYPICAL OF CONTINUOUS-FLOW DRYERS. THE NAME OF THESE SYSTEMS IS DERIVED FROM THE FACT THAT BOTH AIR FLOW AND GRAIN FLOW ARE CONTINUOUS DURING THE DRYING OPERATION. CONTINUOUS-FLOW DRYERS ARE OF EITHER HORIZONTAL-COLUMN OR TOWER TYPE. THE UPPER PORTION OF THE PLENUM AND GRAIN COLUMNS IS THE DRYING SECTION AND THE LOWER PORTION IS THE COOLING SECTION. THE RATE AT WHICH GRAIN MOVES DOWNWARD IN THE DRYER IS DETERMINED BY AN EXHAUST AIR THERMOSTAT CONTROL WHICH REGULATES THE SPEED OF METERING ROLLS, OR SWEEPS, AT THE BOTTOM OF THE COOLING SECTION. SOME MODELS PROVIDE FOR TURNING THE CORN DURING DRYING EITHER BY THE SHAPE OF THE DRYING COLUMN OR BY BAFFLES INSERTED IN THE COLUMN. POWER REQUIREMENTS FOR CONTINUOUS-FLOW DRYERS RANGE FROM 20 TO 100 HORSEPOWER.

A MAJOR ADVANTAGE OF CONTINUOUS-FLOW DRYING IS THE FACT THAT TESTS OF FINAL GRAIN MOISTURE MAY BE TAKEN AT ANY TIME AND ADJUSTMENTS MAY BE MADE TO GAIN GREATER DRYING ACCURACY. THESE SYSTEMS CAN BE EASILY ADAPTED TO AUTOMATIC CONTROL WHICH REDUCES LABOR AND MANAGEMENT DEMANDS. THESE BENEFITS, HOWEVER, ARE POSSIBLE ONLY WITH COMPLETELY INTEGRATED HANDLING AND CONTROL SYSTEMS. BECAUSE OF GREATER INVESTMENT COSTS, CONTINUOUS-FLOW IS ECONOMICALLY PRACTICAL ONLY WITH LARGE-VOLUME OPERATIONS.[6]

---

[6] MILNER, ROSS, IBID.

753

APPENDIX B

INSTRUCTIONAL MATERIALS

TRANSPARENCIES

T-1: FACTS TO CONSIDER IF THE CROP IS TO BE USED FOR LIVESTOCK ON THE FARM

T-2: POSSIBLE CURRENT LOCAL PRICES

T-3: COMPARISON OF PRODUCT PRICES

T-4: HOME OR ELEVATOR STORAGE?

T-5 - 5A: LOCAL ELEVATOR STORAGE PRICES AND POLICIES

T-6: SUGGESTED VOLUME RANGES FOR ALTERNATIVE DRYING METHODS

T-7: PLANNING A GRAIN HANDLING SYSTEM

T-8: PLANNING A GRAIN HANDLING SYSTEM

754

FACTS TO CONSIDER IF THE CROP IS TO BE USED FOR LIVESTOCK ON THE FARM

1. LABOR AVAILABLE FOR FEED GRINDING AND AT HARVEST TIME
2. PRESENT MACHINERY AVAILABLE FOR GRINDING, TRANSPORTATION AND STORAGE
3. DISTANCE TO ELEVATOR OR FEED MILL
4. QUALITY OF GRAIN RECEIVED FROM ELEVATOR
5. BULK SUPPLEMENT SAVINGS AND STORAGE
6. TIMELINESS OF FEED GRINDING

POSSIBLE CURRENT LOCAL PRICES

	GOMER	CAIRO	LANDMARK	CITY FEED	SCOTTS CROSSING
SAT., NOV. 9					
CORN	3.48	3.47	3.49	3.47	3.41
WHEAT	4.68	4.90	4.85	4.73	4.71
SOYBEANS	8.00	8.16	8.16	8.13	8.10

COMPARISON OF PRODUCT PRICES

	LANDMARK	CHICAGO	FUTURES	
			MARCH	JULY
SAT., NOV. 9				
CORN	3.49	3.66	3.88	3.93
WHEAT	4.85	5.04	5.30	4.93
SOYBEANS	8.16	8.40	8.77	8.93

757

HOME OR ELEVATOR STORAGE?

1. FACILITIES AT HOME AND AT ELEVATOR
2. DISTANCE TO ELEVATOR
3. MANPOWER AVAILABLE
4. CONTROL OF MARKET
5. DRYING FACILITIES

LOCAL ELEVATOR STORAGE PRICES AND POLICIES

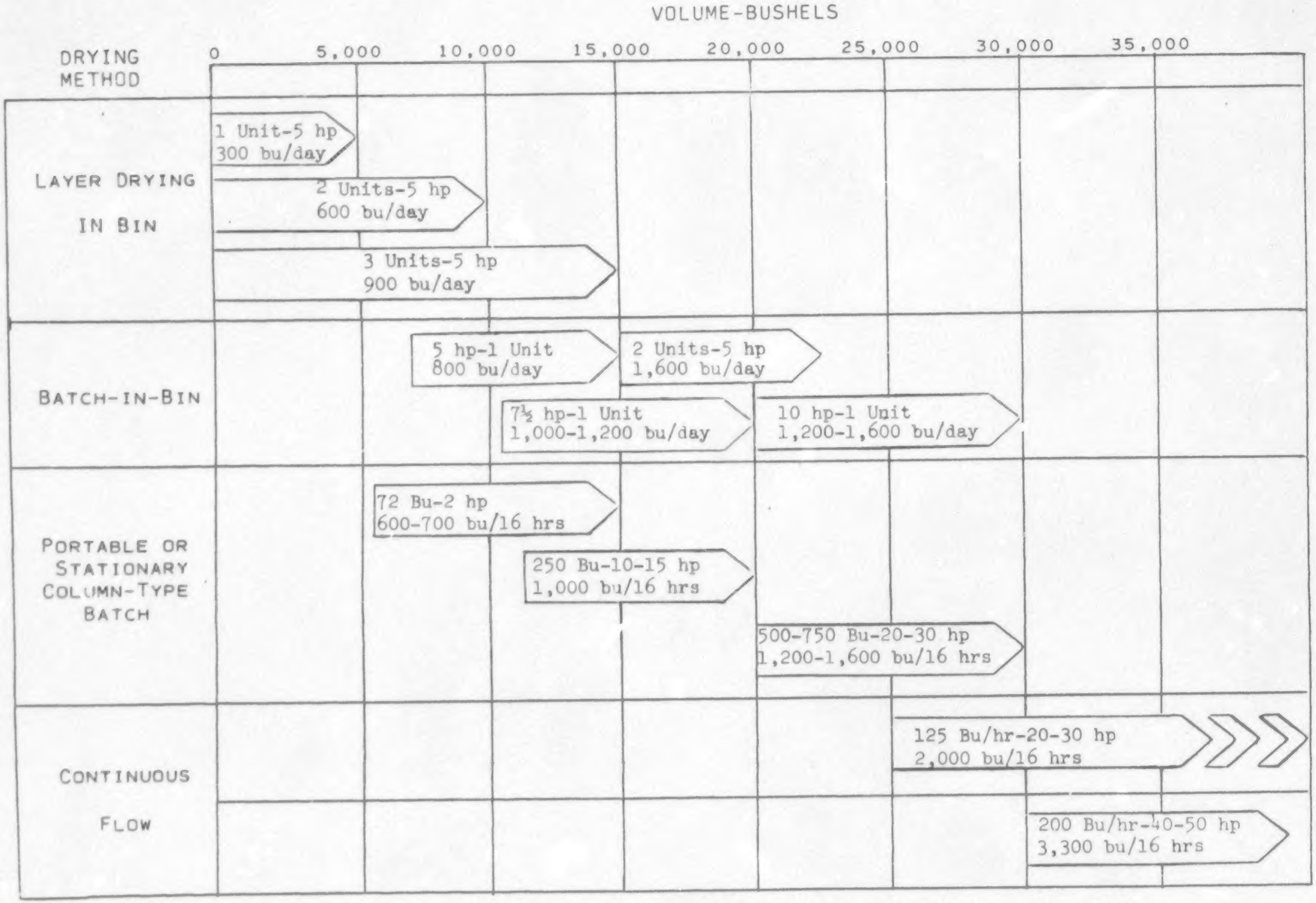
	GOMER	CAIRO	LANDMARK	CITY FEED	SCOTTS CROSSING
Storage Capacity in Bu.	60,000	370,000	500,000	50,000	65,000
Delayed Price	X	X	X	X	X
Dry & Shrink	X	X	X		X
Discount				X	
Cost/Month Beyond Min. Storage	2¢	2¢	2¢ per day	2¢ per day	2¢
Min. Storage					
Corn	15¢ = 6 mo.	15¢ = 10 mo.	14¢=210 day	12¢=6 mo.	10¢=4 mo.
Wheat	20¢ = 6 mo.	21¢ to Feb. 15	15¢=120 day	12¢=6 mo.	20¢=6 mo. 2-1/2¢ after
Soybeans	15¢ = 6 mo.	15¢ = 10 mo.	14¢=210 day	12¢=6 mo.	10¢=4 mo.

LOCAL ELEVATOR STORAGE PRICES AND POLICIES

NAME					
STORAGE CAPACITY IN BU. DELAYED PRICE DRY & SHRINK DISCOUNT COST/MONTH BEYOND MIN. STORAGE MIN. STORAGE CORN					
WHEAT					
SOYBEANS					

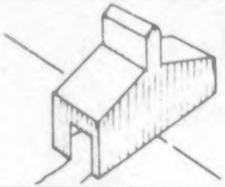
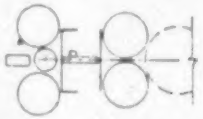
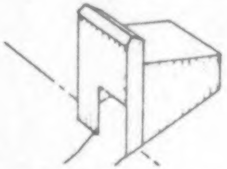
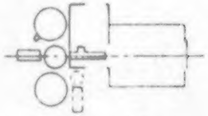
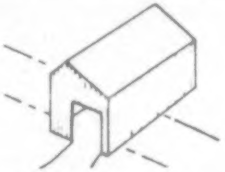
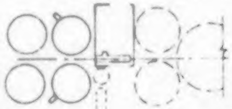
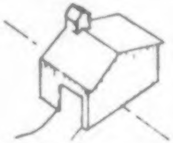
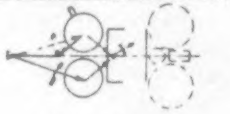
T-5A

SUGGESTED VOLUME RANGES FOR ALTERNATIVE DRYING METHODS*

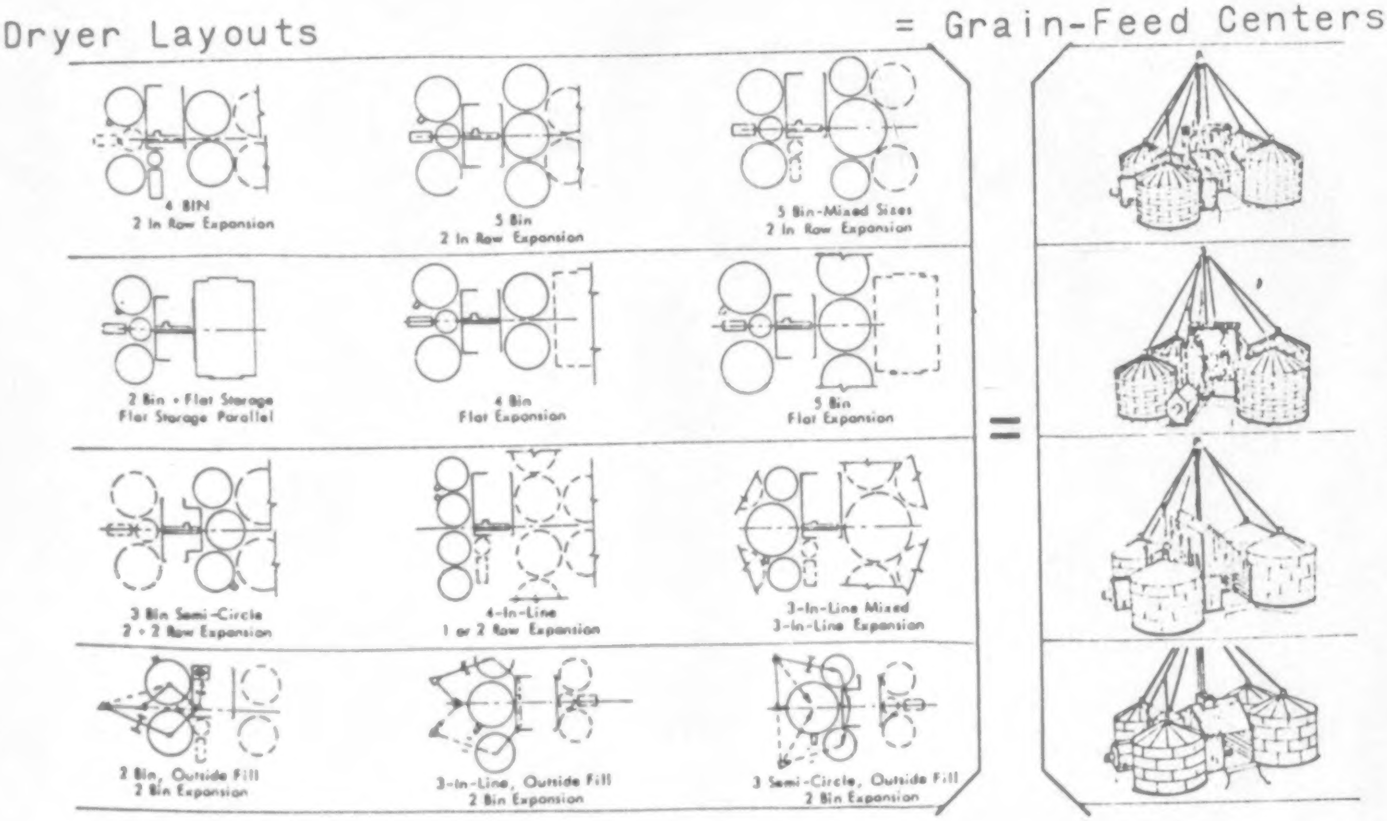


*SELECTING A GRAIN DRYING METHOD (LAFAYETTE, INDIANA: PURDUE UNIVERSITY,

PLANNING A GRAIN HANDLING SYSTEM

Center Buildings			+ Bin and	
CROSS DRIVE WORK TOWER Double Sheds			Round Bins New Units	 4 BIN 1 Row Expansion
CROSS DRIVE WORK TOWER One-Way Shed		+	Round + Flat Storage-New Units	 2 Bin + Flat Storage Flat Storage Perpendicular
PARALLEL WORK TOWER Offset Gable			Existing Bin Adaptions	 4 Bin Cluster 2 + 1 Row Expansion
CUPOLA WORK TOWER Gable Roof			Small Facilities New Units	 2 Bin, Outside Fill 2 Bin Expansion

PLANNING A GRAIN HANDLING SYSTEM


Dryer Layouts
= Grain-Feed Centers
4 BIN
2 In Row Expansion
5 Bin
2 In Row Expansion
5 Bin-Mixed Sizes
2 In Row Expansion
2 Bin + Flat Storage
Flat Storage Parallel
4 Bin
Flat Expansion
5 Bin
Flat Expansion
3 Bin Semi-Circle
2 + 2 Row Expansion
4-In-Line
1 or 2 Row Expansion
3-In-Line Mixed
3-In-Line Expansion
2 Bin, Outside Fill
2 Bin Expansion
3-In-Line, Outside Fill
2 Bin Expansion
3 Semi-Circle, Outside Fill
2 Bin Expansion
=